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A new trematode in a toadfish from southeastern Alaska. HENRY B. WARD and JUDITH FILLINGHAM (Contribution from the Zoological Laboratory, University of Illinois, No. 451).

The material was collected in Alaska in July, 1909, by the senior author. It came from a toadfish which was not more precisely determined. The fish was obtained from a salmon trap in Excursion Inlet on Icy Straits. The host was heavily infected and 150 or more specimens of the parasite were taken from different parts of the intestine. The preparations and drawings were made by the junior author. The material thus secured was worked up recently by both authors.

Opechona alaskensis, n. sp.

Description.—Small, spiny distomes; elongate, flattened, translucent, anterior end bluntly pointed, posterior end broadly rounded. Length 1.8 to 3.5 mm; width 0.159 mm through pharynx and 0.275 mm at anterior testis. Oral sucker nearly terminal, 0.082 by 0.092 mm; ventral sucker midway between ovary and pharynx, 0.117 by 0.112 mm. Prepharynx unusually long, from 0.11 to 0.2 mm, slightly expanded at entrance to pharynx, which is nearly spherical with diameter of 0.074 mm. Esophagus long, tubular, simple; pseudo-esophagus lined with intestinal cells. Intestinal fork 0.1 mm in front of acetabulum, crura extending nearly to posterior end. Excretory bladder, median, reaching anteriad to, or just beyond, posterior margin of acetabulum. Germ glands in linear series; ovary 3-lobed, in front of testes which lie tandem in anterior half of posterior third of body. Genital pore anterior and left of acetabulum. Genital sinus large, ovoid. Cirrus conical; cirrus pouch with prostate gland and vesicle enclosed, to which is connected also a flask-shaped external vesicle. Vitellaria lateral, extending from in front of fork of intestine to posterior end, confluent in front of acetabulum and behind testes, extending dorsal, ventral and lateral to crura; yolk reservoir large, ventral to seminal receptacle. Laurer's canal and Mehlis' gland present. Uterine coils anterior to ovary and between intestinal crura, well filled with operculate eggs 83μ by 45μ.

Host.—Toadfish.

Location.—Intestine.

Type locality.—Alaska Excursion Inlet.

Type specimens.—Ward Helminthological Collection, No. 31.81; paratypes U.S.N.M. Helm. Coll. (Ward No. 31.83).

STRUCTURE OF THE PARASITE

The worm appears long, flat and somewhat rounded at the ends (fig. 8); the specimens are somewhat compressed dorso-ventrally. The anterior end is more blunt, the posterior end slightly rounded. Measurements made of mounted specimens range in length from 1.8 to 3.5 mm, with an average length of 2.44 mm. The average width is 0.159 mm through the pharynx, and 0.275 mm through the anterior testis.

Preserved specimens are distinctly brown in color due to the great extent of the vitellaria. Anteriorly the body is lighter so that the oral sucker and pharynx are readily visible.

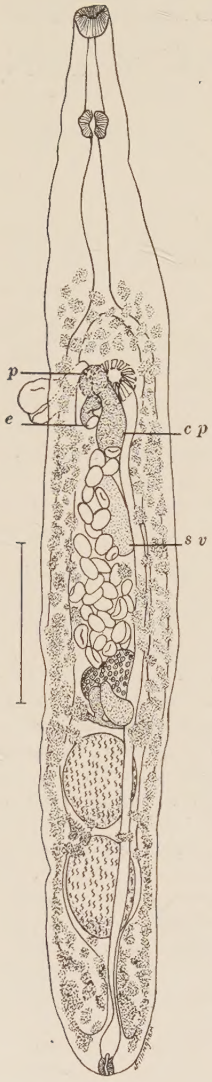

Fig. 8.
Opechona alaskensis, n. sp.
Dorsal view. *c p*, cirrus pouch; *e*, egg; *p*, genital pore; *s v*, external seminal vesicle. Drawing from camera lucida outline of specimen fixed, stained and mounted. Scale 0.5 mm.

Small retrorse spines cover the surface of the cuticula, but not evenly distributed. Anteriorly they are thickly set and are comparatively long. Posteriorly the spines decrease in number and in size. At the posterior end of the body, the spines appear to be merely elevations of the cuticula.

The arrangement of the spines gives the cuticula the general appearance of being divided into diamond-shaped areas. However, the spine pattern is not to be confused with the pattern formed by the overcrossing of the 2 sets of diagonal body muscles which may show plainly in well cleared specimens. They too, give the body surface the appearance of being divided into diamond-shaped areas, but apparently there is no relation between the spine and muscle patterns.

The oral sucker is nearly round, measuring on the average 82μ in length and 92μ in width. The acetabulum lies about 0.756 mm from the anterior end of the worm, or near the posterior border of the anterior third of the body. It is ventral to the cirrus pouch, to the right of the genital pore and almost half way between the ovary and the pharynx. The acetabulum shows average dimensions greater than those of the oral sucker: length, 0.117 mm and width, 0.112 mm.

The mouth, surrounded by the oral sucker, opens somewhat ventral; posterior to it is the prepharynx which is unusually long, varying in length from 0.11 mm to 0.2 mm. The average length is about 0.18 mm and the width only 40μ.

The prepharynx opens directly posteriad into the pharynx. Measurements taken from totos show an average length of 72μ and an average width of 74μ.

Opening directly from the pharynx is the long, less muscular esophagus. The cuticula lining the regions of the digestive system thus far discussed, forms the lining of the esophagus to a point 70 to 80μ anterior to its branching to form the intestinal crura. Posterior to this point, the wall has the structure of the intestinal crura.

The branching of the esophagus to form the intestinal crura occurs slightly anterior (about 0.1 mm) to the acetabulum, and near the point of opening of the genital pore. Each crus extends laterally, and then bends posteriorly to end as a blind sac about 0.1 mm from the posterior end of the body. The crura are practically equal in length. The cells with darkly stained nuclei lining the posterior part of the esophagus also form the lining of the crura.

The excretory bladder is a long unpaired, unbranched sac, reaching anteriorly to a point near the level of the posterior border of the acetabulum and occasionally anterior to it. It lies dorsal to the acetabulum and at this point ventral to the cirrus pouch. In this region, in cross section, it is flattened laterally and is elongate dorso-ventrally, its greatest lateral diameter about 17μ and its dorso-ventral diameter about 66μ. In the region of the testes, and in reference to them, the bladder assumes a dorso-lateral position; in this region it lies dorso-mesal to the right crus. About 45 to 50μ from the posterior end of the caudal testis, the bladder swings medially and comes to lie in a dorsal position between the two intestinal crura. After a short distance it expands, forming a bulb-like region. About 19μ from the posterior end, the bladder forms a narrow canal which opens dorsally to the outside by the excretory pore. Surrounding the canal is a strong sphincter muscle.

The 2 testes lie, one directly behind the other, in the median anterior portion of the posterior third of the body. The average distance from the posterior border of the caudal testis to the posterior end of the worm is about 0.296 mm. In some cases they are widely separated; in others they are found in direct contact. The length of the caudal testis is slightly greater than that of the anterior testis; the width is about the same. Average measurements are: Anterior testis 0.21 mm long by 0.159 mm wide; posterior testis 0.23 mm long by 0.159 mm wide.

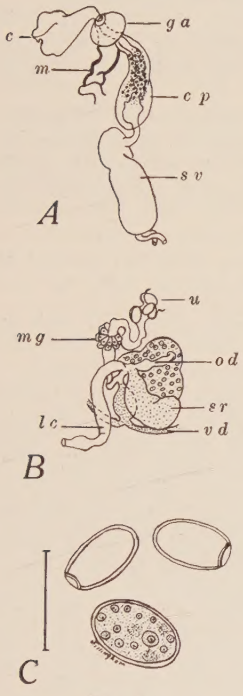

FIG. 9.
Opechona alaskensis, n. sp.
A—Genital pore complex, diagrammatic. B—Genital gland complex, diagrammatic. C—Ova. Scale 0.1 mm. *c*, cirrus partly extended; *c p*, cirrus pouch; *g a*, genital atrium; *l c*, Laurer's canal; *m*, metraterm; *m g*, Mehlis' gland; *o d*, oviduct; *s r*, seminal receptacle; *s v*, external seminal vesicle; *u*, uterus; *v d*, transverse yolk duct near yolk reservoir. Drawings from camera lucida outlines of specimens fixed, stained and mounted.

The seminal vesicle is composed of 2 parts, a posterior portion, which lies in the body posterior to the cirrus pouch, and an anterior portion which is contained in the pouch along with the pars prostatica, ductus ejaculatorius and cirrus. The posterior portion is somewhat bottle-shaped, and lies diagonally in the body, its broad posterior end extending ventrally to the right, its anterior smaller end extending dorsally to the left. This end becomes small and tube-like, and enters the cirrus sac as a crooked neck, enlarging almost immediately on entrance to form the somewhat irregularly shaped anterior portion of the seminal vesicle. This part of the vesicle narrows anteriorly and passes as a coiled tube into the darkly stained region of the prostate glands, as the pars prostatica.

Beyond the region of the prostate glands, the long, straight ductus ejaculatorius passes to the short common genital atrium. At the end of the ductus, usually protruding from the genital pore, is the cone-shaped cirrus. The pouch in this region is thick-walled and muscular; it ends at the entrance to the atrium.

The genital atrium lies to the left of the ventral sucker. The genital pore is slightly to the left of the median line, and anterior to, though in some cases almost in a line with, the opening of the acetabulum on the ventral surface of the body. It is posterior to the junction of the intestinal crura.

The ovary lies anterior to the testes at an average distance of 46μ from the anterior testis. In some specimens it may lie slightly on the right side, but it is very nearly median in position. It is 3-lobed, the most anterior lobe pointing towards the right side, the other 2 lobes lying opposite and posterior.

The seminal receptacle lies dorsal to the ovary. It is broad, club-shaped and twisted near the anterior end as it bends left and then right. In some specimens it almost touches the anterior testis; in others separated by a distance of 35μ.

Near the posterior border of the seminal receptacle and ventral to it in the median line, 2 vitelline ducts coming from the 2 sides join, forming a common vitelline reservoir (fig. 9B). The duct from the left side lies somewhat anterior to the right duct. The reservoir is large, bulbous and slightly elongate, lying to the left of, and ventral to, the seminal receptacle. It opens anteriorly into the oviduct, a short distance from the point of entrance of Laurer's canal, which has its external opening on the dorso-lateral surface.

Near the anterior lobe of the ovary, and to the left of it, the oviduct is surrounded by darkly staining cells, forming Mehlis' gland. Anterior to the glandular region, the tube opens into the wide convoluted uterus.

The uterus, which in mature specimens is filled with eggs, occupies the entire body space between the intestinal crura. All the coils lie anterior to the

ovary. Near the cirrus pouch the tube is thick-walled and muscular (fig. 9A); this is the metraterm, which at its anterior end opens into the genital atrium.

The irregular granular vitellarian follicles are very numerous; in some places they almost obscure the organs lying beneath. Anteriorly they extend beyond the fork of the intestinal crura and even half way to pharynx, and posteriorly to the posterior end of the crura and in some cases slightly beyond. They lie dorsal and ventral as well as lateral to the intestinal crura; in the regions posterior to the testes and anterior to the acetabulum they usually come together in the mid-line; elsewhere they are lacking in the median area.

The eggs bear at the blunt end an operculum (fig. 9C); their number varies from about 30 to 50 in the individual specimen. Measurements give a general average of 83μ in length by 45μ in width; individual size varies from 70μ by 40μ to 94μ by 53μ.

The musculature is relatively strong and specimens shrink about 15 percent in the process of staining and mounting. An extended series of careful measurements show that this shrinkage is roughly proportional in all organs and regions of the body. The specimens appear delicate and transparent in the alcoholic material as well as in life.

Opechona bacillaris (Molin, 1859)

The first record of a similar parasite is that of Molin (1859:19) who described a form he found in the Adriatic as *Distomum bacillare*. Olsson (1868:36) described a similar form under a different name and without reference to Molin's work. Olsson's species remained unplaced for some years until Odhner (1904:332) compared specimens of *Distomum bacillare* Molin from the Adriatic with typical *Distomum increscens* Olsson and found they were identical; hence he stated the latter designation must be cancelled. This apparently applies to all of Olsson's records under this designation from *Scomber scombrus* and not to a portion of them as some later writers cite his findings. However, Dollfus (1925) calls attention to another form from *Merluccius vulgaris* for which Olsson later used the same name. Stossich (1887:92) had redescribed Molin's species but omitted some important features, viz., the cuticular spines and the external seminal vesicle. However, Nicoll (1910:342) was able to secure some of Stossich's material and by examination demonstrate its identity with the species from the English coasts which Lebour (1908) and he (1910) had worked over. Finally Markowski (1933:12) has described and figured what, as he states, is clearly the same species. These records showed that the species occurred over a wide range from the Irish Sea and the Baltic to the Adriatic and that it was abundant at most places studied. The records also indicate its occurrence in a considerable number of fish hosts, including both bottom feeders and surface swimming types, as is shown in the following paragraph.

Found originally by Molin in *Centrolophus pompilius*, where it occurred in numbers in the pyloric caeca, it was next taken also in Mediterranean waters by Stossich at Trieste in *Scomber scombrus* and about the same time by Olsson in the same host from the west coast of Sweden. The first specimen Lebour found was taken from the whiting (*Gadus merlangus*) on the Northumberland coast, but later she secured the same species from a flounder (*Rhombus laevis*) and a rockling (*Onas mustela*). Nicoll collected this material first in quantity from mackerel (*Scomber scombrus*) at Millport and later from the lumpsucker (*Cyclopterus lumpus*), the sprat (*Clupea sprattus*), the herring (*Clupea larengus*), and the boarfish (*Capros aper*) at other places. The infection was generally heavy and occasionally enormous. Most recently Markowski (1933) found the same parasite frequent in *Scomber scombrus* in the Polish Baltic. He regarded it as a form that did not belong to the Baltic but came in summer with the large fish that wandered in from the North Sea.

The structure of *Distomum bacillare* was only imperfectly described by earlier authors. Later it has received good attention. Lebour (1908:22) was the first author to give a real description of the structure of this species for which she established a new genus, *Pharnygora*, and regarding her specimens

also as representatives of a new species, named it *Pharnygora retractilis*. The general resemblance of her species to *Distomum bacillare* was commented on by Lebour but, misled by defects in the original description as given by Molin, she regarded her form as a distinct species and worthy of generic rank.

This species was restudied by Nicoll (1910:341). He recognized its identity with the form that Molin had described much earlier and gave a complete and accurate account of its structure, correcting many minor errors in the work of earlier authors. As already noted his conclusions were fortified by comparison of material from collections made by earlier authors.

This species while in the metacercaria stage has been found often as a parasite of various medusae. Thus Lebour (1916) reported it from Plymouth (England) in *Obelia* sp. *Cosmetira pilosella, Turris pileata* and *Phialidium hemisphericum,* as well as in the ctenophore, *Pleurobrachia pileus.* The parasite was clinging to the wall inside the gastric cavity and occurred abundantly from early summer to autumn and even infrequently as late as December. It was never found encysted. Stunkard also found it in the same ctenophore at Roscoff. Lebour later (1917:202) reported it from *Sagitta bipunctata.*

Probably its occurrence in such hosts is adventitious. The frequency of such occurrence in purely pelagic hosts indicates that the cercaria is free-swimming and the adult is abundant at the season and location indicated.

THE GENUS OPECHONA

In discussing what he regarded as an improper method of designating a genus, Looss (1907:616) used the name *Opechona* for a suppositious genus of which the type would be *Distoma bacillare.* But opinion 1 B of the International Rules of Zoological Nomenclature states that designation of a type constitutes an indication which apparently establishes the validity of the genus name. Since this communication was about a year earlier than the article by Lebour in which the generic name *Pharyngora* was used and the genus described with the species *Ph. retractilis* as type, and since, as shown in this article, that species has been shown by Nicoll first and various other authors later to be synonymous with the earlier species of Molin, one is compelled to accept the name suggested by Looss. In this article it is consistently used for the genus.

Lebour who suggested that a new genus *Pharyngora* be established for the species she described, placed that genus in the subfamily Lepocreadiinae Odhner (1905). This subfamily was included in the family Allocreadiidae established by Odhner later and this disposition of the parasite has been regularly followed since that time.

Three parasites previously described have been assigned to the genus *Pharyngora: Ph. bacillaris* (Molin, 1859), *Ph. orientalis* Layman, 1930, and *Ph. gracilis* Manter, 1931. The first of these which is the one best known has already been fully discussed. The others are much alike in general features but readily distinguishable as will appear from a brief survey.

Opechona orientalis (Layman, 1930) n. comb.

The second species discovered came from the east coast of Siberia and was described by Layman (1930:93) as *Pharyngora orientalis.* While closely resembling *Op. bacillaris* the new species was distinctly differentiated by the length of the prepharynx, the small size of the suckers, of the pharynx and of the ova. The extent of the vitellaria is discussed later. The location of the genital pore as median, whereas in other species it lies on the left anterior margin of the acetabulum, may not represent a real difference. The eggs measure 54 to 62μ by 32 to 35μ. The host of this species is *Scomber japonicus* Houttuyn. The parasite was found only in 2 of the 6 fish examined; one host contained 5 parasites and the other only 1.

Opechona gracilis (Manter, 1931) n. comb.

This parasite was described by Manter (1931) from *Menidia menidia,* the silversides, at Beaufort, N. C.; it was common in the intestine of that host. It is distinguishable by smaller size of body, lobed testes, and suckers of equal size. Manter mentions the anterior extent of the vitellaria as the chief difference between this species and *Op. bacillaris;* this feature is discussed later in our paper, but it is not the only basis for separating this species from the others described herein. It is the smallest species of the genus yet discovered, and measures only 0.84 to 1.5 mm in length by 0.18 to 0.4 mm in width. The ova measure only 64 to 72μ by 39μ.

Opechona alaskensis Ward and Fillingham

The definition of the genus *Pharyngora* (=*Opechona*) as written by Lebour (1908) and amended by Nicoll (1910) agrees with the description we have given of our species in all major items. However, in our species no pigment patches were found alongside of the pharynx; the prepharynx is long as is also the esophagus, instead of comparatively short as in Nicoll's characterization of the genus *Pharyngora.* Manter's species, *Op. gracilis,* agrees with ours in having prepharynx and esophagus relatively long. The same is true of *Op. orientalis.* These are clearly new features, specific in character, and the definition of the genus is not materially affected by the changes they involve.

EXTENT OF VITELLARIA

Some of the points on which Nicoll's description disagrees with Lebour's suggest that perhaps after all 2 species may be involved and the corrections he made are actually specific differences. Thus he gives the length of the prepharynx as only 1/3 that of the pharynx, *or less,* whereas she makes it 3 times the length of the pharynx, explaining this condition as due to complete extension of the organ. More significant is the anterior extent of the yolk glands which Nicoll limits "to the level of the posterior end of the cirrus-pouch. They cover the intestinal diverticula and overlap the testes to a slight extent. The variation in the anterior limit of the yolk glands is very small and they never reach the ventral sucker as is shown in Miss Lebour's figure of *Pharyngora retractilis.*"

Now the examination of the figures published by these 2 authors shows differences that are hard to reconcile on the view that they were handling the same species and these differences can be seen in other organs, even though most conspicuous in the vitellaria.

This feature is discussed here because authors generally regard the extent of the vitellaria as subject to little if any variation and, in the species of *Pharyngora* (=*Opechona*) previously described, in separating these species emphasis has been laid on the extent of the vitellaria. This factor is stated for these species as follows for the anterior limit of the vitellaria:

Op. bacillaris—Center of ventral sucker (Lebour).
Posterior end of cirrus pouch (Nicoll).
Level of vesicula seminalis interioris (Markowski).
Op. orientalis—Posterior margin of cirrus sac (Layman).
Op. gracilis—Anterior limit of pseudo-esophagus (Manter).
Op. alaskensis—In front of fork of intestine (Ward and Fillingham).

In regard to lateral relations between right and left vitellarian follicles the conditions as stated in the text and shown in figures of the authors indicated are as follows:

Op. bacillaris—Between and behind testes (Lebour).
Confluent behind posterior testes only (Nicoll).
Also above and between testes (Markowski).
Op. orientalis—Not shown between testes (Layman).
Op. gracilis—Behind posterior testes only (Manter).

Op. alaskensis—Behind posterior testis, between testes scantily and above intestinal fork conspicuously (Ward and Fillingham).

Other features make probable the specific distinctness of the 4 species listed, although the case is less well established if one may assume as large variations in the extent of the vitellaria as indicated for a single species in the figures and descriptions as given by Lebour, Nicoll and Markowski for *Op. bacillaris.*

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Losses among wild ducks due to infestation with *Sphaeridiotrema globulus* (Rudolphi) (Trematoda; Psilostomidae). E. W. Price

During the past several years 3 outbreaks of a fatal disease of ducks have occurred in the vicinity of Washington, D. C., the species of duck involved in each instance being the lesser scaup, *Marila affinis.* This trouble was first brought to the attention of the U. S. Bureau of Animal Industry on October 31, 1928, when 2 dead birds were sent to the Zoological Division by the Bureau of Biological Survey with a request for information as to the cause of the disease, and on November 12, 1928, another duck was sent in from the same locality. Inquiries developed the fact that there had been extensive loss, as many as 16 dead birds having been observed in a single day along the Potomac River between Washington, D. C., and Fort Washington, Md. This outbreak was briefly described in abstract form by the writer (1929, J. Parasitol. 16: 103-104).

On October 28, 1930, a second outbreak of the disease was brought to the attention of the Bureau of Animal Industry when 3 female scaup were forwarded to the Zoological Division by Mr. Talbott Denmead of the Bureau of Biological Survey. These birds had been picked up by a hunter near the mouth

of Broad Creek, a stream which empties into the Potomac River near Fort Washington, Md. The hunter reported that 30 to 35 dead and dying birds were found floating on the water. On October 30, four additional birds were picked up near the mouth of Broad Creek, by Mr. L. A. Branchaud of the Bureau of Biological Survey, and sent to the Bureau of Animal Industry for an examination to determine whether the birds had died of an infectious disease. These birds were referred to the Zoological Division to be examined for parasites.

During the fall of 1931, a similar outbreak occurred, and 1 bird was referred for examination, by Dr. J. E. Shillinger of the Bureau of Biological Survey to the Bureau of Animal Industry. No details as to the extent of this outbreak could be obtained.

The lesions found in the birds in all of these outbreaks were essentially the same, and were caused by a small trematode which has been identified as *Sphaeridiotrema globulus* (Rudolphi) a species which had not previously been incriminated as pathogenic.

POST-MORTEM FINDINGS

The birds examined from the 3 outbreaks mentioned above were in fair condition, a moderate amount of subcutaneous and visceral fat being present. The viscera were pale, but otherwise appeared normal except for a reddening of the lower part of the small intestine. The small intestine of the birds from the 1928 outbreak showed an intense hyperemia in a section about 20 cm in length about 15 to 20 cm anterior to the ceca. The gut along this area was completely filled with a cast composed largely of fibrin and blood. The mucous membrane was highly congested and hemorrhagic, and showed numerous small ulcerated patches. Close examination of these ulcers showed numerous small trematodes firmly attached. The remainder of the intestinal tract appeared normal except for the ceca which in 1 bird were slightly reddened and contained a few specimens of an amphistome, *Zygocotyle lunata* (Diesing). A few specimens of a minute fluke and several tapeworms of the genus *Fimbriaria* were found throughout the course of the small intestine of all the birds.

In the birds examined from the 1930 outbreak, the intestinal lesions were essentially the same as those of the birds examined in 1928, but somewhat more extensive. In these birds the lower part of the small intestine from the ceca anteriorly for a distance of about 40 cm showed an intense hyperemia, the lumen was filled with a cast of fibrin and blood, and the mucous membrane showed lesions similar to those found in the birds examined from the 1928 outbreak. The same species of trematode was found associated with the lesions. In the section of the gut anterior to the involved area numerous small trematodes were found, and in two of the birds a heavy echinorhynch infestation was found. The bird examined from the 1931 outbreak showed lesions of the same kind as those from previous outbreaks, and the same fluke was found associated with the lesions.

HISTOLOGICAL FINDINGS

The serosa, and muscular and mucous layers of the intestine showed evidence of an acute hyperemia, the arteries, veins, and smaller vessels being engorged with blood. The mucous membrane showed a pronounced desquamation of epithelium, the villi being entirely denuded in most areas. There was also severe ulceration in places, the ulcers frequently extending as deep as the muscularis. The tunica propria and submucosa showed a pronounced leucocytic infiltration. The muscular coats were also noticeably infiltrated with leucocytes and this infiltration extended into the serosa. A section through the unopened gut showed the lumen filled with a mass composed largely of desquamated epithelium, fibrin, and blood. The ulcerated areas contained numerous trematodes firmly attached to the tissue by means of their powerful suckers.

DISCUSSION

From the above description it appears that the injury to the mucous membrane by the trematodes was the primary cause of the enteritis which resulted in the death of the birds. Whether the acute inflammation was due solely to the effects of the parasites or in part to a secondary bacterial invasion was not determined. That the flukes were the primary cause of the condition is quite apparent, since they were found only in the inflamed section of the gut, and no other lesions were present which would in any way account for the deaths of the birds.

The tapeworms and other flukes appear to be of no significance in these cases, since they were found in the greatest abundance in the unaffected portion of the intestine. The acanthocephalids are also excluded as a factor of importance as they were present in only 2 of the birds, and birds free from these parasites showed lesions as pronounced as those infested with these worms.

DESCRIPTION OF THE PARASITE

The worms collected from the ulcerated areas of the intestine were light pink in color when fresh, but this color soon disappeared when the worms were placed in water or physiologic saline. They are spherical to piriform in shape and have the general appearance of a small seed.

This fluke belongs to the genus *Sphaeridiotrema* Odhner, 1913, of the family Psilostomidae Odhner, 1913, and agrees closely with the description as given by Braun (1902, Zool. Jahrb., Abt. Syst. 16: 1-162) and by Lühe (1909, Süsswasserfauna Deutschlands, Heft 17:60) for *Sphaeridiotrema globulus* (Rudolphi, 1819) except for some slight differences in position of testes and size of eggs; these differences are regarded as too slight to be significant. Existing descriptions of this species are very incomplete, so a redescription based entirely on specimens collected by the writer is given here.

Sphaeridiotrema globulus (Rudolphi, 1819) Odhner, 1913

Synonym.—Distoma globulus Rudolphi, 1819.

Description.—Body piriform to spherical, 675 to 852μ long by 562 to 796μ wide, thickness about equal to width. Cuticula thick, smooth and devoid of spines. Oral sucker slightly subterminal, 150 to 165μ in diameter; acetabulum very large and powerful, transversely oval, 260 to 375μ long by 390 to 413μ wide, its opening about 110μ long by 260μ wide. Prepharynx very short, seen only in sections; pharynx strongly muscular, 90μ long by 60 to 75μ wide; esophagus short; intestinal ceca thin-walled, extending to near posterior limits of vitellaria. Genital pore to left of median line at level of posterior margin of oral sucker. Cirrus pouch pestle-shaped, 225μ long, its posterior end lying in median line immediately in front of anterior margin of acetabulum, containing a simple piriform seminal vesicle, a few prostate cells, and a strong protrusible cirrus. Testes transversely oval, 225 to 387μ by 150 to 320μ, at posterior end of body, varying somewhat in position in different specimens, one either antero-dorsal of the other or dorso-lateral of the other, the position apparently influenced by the extent of contraction or extension, or by pressure. Ovary spherical or slightly ovoid, 135μ in diameter, to right of median line and immediately anterior to testes. Mehlis' gland well developed. Seminal receptacle and Laurer's canal apparently absent. Uterus consisting of few coils lying mostly in front of acetabulum, containing as many as 60 eggs. Vitellaria consisting of large follicles surrounding intestinal ceca dorsally, ventrally, and laterally, and extending from about level of pharynx to slightly beyond level of anterior margin of testes; in anterior part of body, follicles extending across dorsal surface but not meeting to form a complete band. Eggs oval, 90 to 105μ long by 60 to 67μ wide, golden yellow in color, with moderately thick shells.

Host.—Marila affinis.

Location.—Small intestine.

Distribution.—United States (Maryland).

This species has been reported from Europe as occurring in *Cygnus olor, Dafila acuta, Nyroca marila, N. fuligula, Clangula hyemalis, Mergus merganser, M. serrator,* and *Alca torda;* no indication of pathogenicity was given in connection with reports of this parasite from European hosts.

A new term for the adhesive organs of trematodes. E. W. Price.

The adhesive organs of the monogenetic trematodes have received a variety of names, such as holdfast organs, adhesive organs, cotylophore, etc., but no single term has been proposed that is generally applicable for the reason that the adhesive structures of these trematodes exhibit such extreme variation. In order to avoid the use of different terms for these apparently homologous structures, the writer proposes *haptor* (ἁπτω—fasten to, fix upon, attach) as a term which conveys a definite meaning without morphologic implication. Such a term is as applicable in describing the adhesive organs of a tristome as it is in describing similar organs of gyrodactylids, polystomes and microcotylids. The term haptor is also suggested as a substitute for "holdfast organ" or "clinging plug" of the strigeids and for the peculiar sucker-like adhesive organ of the aspidogastrids. It is not proposed that the term haptor supplant "oral sucker" and "acetabulum" of the digenetic trematodes, since these structures show little modification throughout the group and are suckers in the true sense of the word.

Some observations on the cercaria and redia of a species of *Clinostomum*, apparently *C. marginatum* (Rudolphi, 1819) (Trematoda: Clinostomidae). Wendell H. Krull.

A furcocercous cercaria collected at Beltsville, Maryland, from the snail *Helisoma antrosa,* has been found to penetrate pumpkin-seed fish, *Eupomotis gibbosus,* and develop into the metacercaria of a species of *Clinostomum,* apparently *C. marginatum* (Rud., 1819). The cercariae forming the basis of the following description and the cercariae used in the experiment were secured from a single snail. The fish, specimens of *Eupomotis gibbosus,* which were used in the experiment, were free from trematode infestation, as was demonstrated by controls and by the fact that repeated examinations of the fish collected during a period of 3 years from one particular pond were always negative. The cercariae attacked the uninfested fish, and from these fish metacercariae were obtained which corresponded to those obtained from fish naturally infested.

The majority of the specimens of *E. gibbosus* from the pond in which the infected snail was obtained, were naturally infested. Some pumpkin-seed fish infested with metacercariae of *Clinostomum,* collected from the pond, were fed to a young black-crowned night heron, *Nycticorax nycticorax naevius* (Bodd.), and 3 days later numerous eggs were collected from the feces, and mature flukes also were recovered from the mouth of the heron. The bird was hatched and raised in captivity at the U. S. National Zoological Park, and kindly supplied to the writer by Dr. Wm. M. Mann, Director of the Park. Further details of the life history of the fluke will be given in a later paper.

The cercaria (fig. 10) is pigmented, pharyngeal, furcocercous, lophocercous, 465 to 503μ (average 486μ) long; body, 120 to 138μ (average 130μ) long by 30 to 32μ (average 31μ) wide, convex dorsally and concave ventrally, devoid of spines except anteriorly. Anterior tip of body proper covered with approximately 9 transverse rows of alternately staggered heavy spines extending posteriad for 1/3 to 1/4 the length of penetration organ, and with a band of more delicate and somewhat longer irregularly arranged spines beginning at level of middle of penetration organ and extending to level of its posterior end. Dorsal median fin fold present, delicate, 7 to 8μ wide in living specimens, extending from level of eyespots to posterior end of body proper. Eyespots pigmented, 7 to 8μ long in living specimens, crescentic in optical section, their concavities directed laterally and slightly dorsally, situated dorso-laterally and slightly anterior to middle of body proper. Penetration organ elongated, 37 to 40μ (average 39μ) long. Mouth

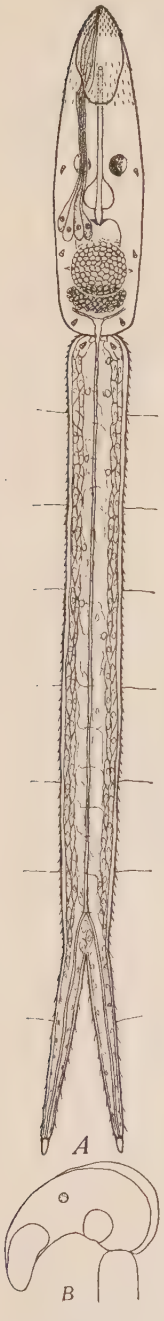

FIG. 10.

A—Cercaria, ventral view. Penetration glands omitted on one side. B—Cercaria body, lateral view, showing fin fold and its position in relation to tail when suspended in water.

median, ventral, slightly posterior to middle of penetration organ, opening into long and conspicuous prepharynx extending to level of posterior margins of eyespots, terminating in a large, delicate pharynx. Esophagus about ½ as long as pharynx, thickened posteriorly and terminating in a thin-walled, almost spherical, sac-like, undivided cecum. Primordium of acetabulum represented by a mass of cells somewhat smaller than penetration organ, exposed at ventral surface of body, overlapping cecum for part of its length. A somewhat irregular mass of cells, probably representing primordium of genital organs, lying near posterior end of body dorsal to primordium of acetabulum and overlapping it for a variable distance. Penetration gland cells 4 pairs, at level of cecum, opening at anterior tip of penetration organ. Excretory bladder small, elongated, at posterior end of body proper, receiving pair of antero-lateral collecting tubules. Caudal extension of bladder, somewhat dilated at anterior end, continuing through tail to near furcae, then bifurcating, branches continuing and traversing furcae. Flame cells 5 pairs, arranged as in figure 10A. Tail stem somewhat narrower than body proper, 250 to 285μ (average 268μ) long; furcae 75 to 98μ (average 88μ) long, including small fins comprising their tips. Tail stem and furcae spined, the spines on furcae being somewhat larger, fewer, and more irregularly arranged than on tail stem; long filamentous hairs on tail stem, with at least 1 pair on furcae.

The measurements in the above description, except where otherwise indicated, were taken from a series of specimens killed in hot 5 percent formalin and measured in this solution. The following average measurements were obtained from a series of unpreserved specimens measured at time of death under cover glass: Body 175μ long, penetration organ 40μ long, tail stem 280μ long, furcae 124μ long.

The eyespots and the prepharynx are the most conspicuous organs in the cercaria. The cercaria is exceedingly delicate and the filamentous hairs and fin fold begin to disintegrate very soon after mounted preparations are made. In order to obtain details of anatomy it was necessary to use cercariae obtained by dissection.

The cercariae are short lived and are infective for only a comparatively few hours. After escaping from the snail the cercariae suspend themselves for a short time in the water with the anterior end hanging down, then slowly settle to the substratum. When suspended in the water the furcae are held relatively close together, the body is curved ventrad, and the penetration organ takes a position relatively close to the base of the tail stem as shown in figure 10B. On striking the substratum the cercariae are stimulated to activity and regain their former positions by lashing their tails.

The cercariae are produced in rediae which infest the digestive gland, and are difficult to separate from this gland. The largest redia measured in the living condition was 490μ long by 140μ wide; pharynx 36μ long by 27μ wide. The redia has a broad intestine extending usually to near posterior end of body. Each redia is filled with many cercariae. The anterior end of the redia is covered with rather large spines arranged in transverse rows and extending to a level somewhat posterior to the pharynx.

The cercaria described above is very similar to *Cercaria whitentoni* described by Croft (1934, Tr. Amer. Micr. Soc., 52: 259-266), except for the presence of a large pharnyx and in the spination of the anterior end of the body. These differences, however, may be only apparent and it is possible that the 2 cercariae are identical.

A new trematode, *Notocotylus hassalli*, n. sp. (Notocotylidae), from a meadow mouse. Allen McIntosh and Gertrude E. McIntosh.

On post-morten examination of a female specimen of *Microtus pennsylvanicus pennsylvanicus*, captured May 19, 1934, on the shore of Piscataway Creek, near the village of Piscataway, Maryland, a single specimen of a monostome fluke was found in the caecum. This fluke is regarded as new and for it the name *Notocotylus hassalli* is proposed.

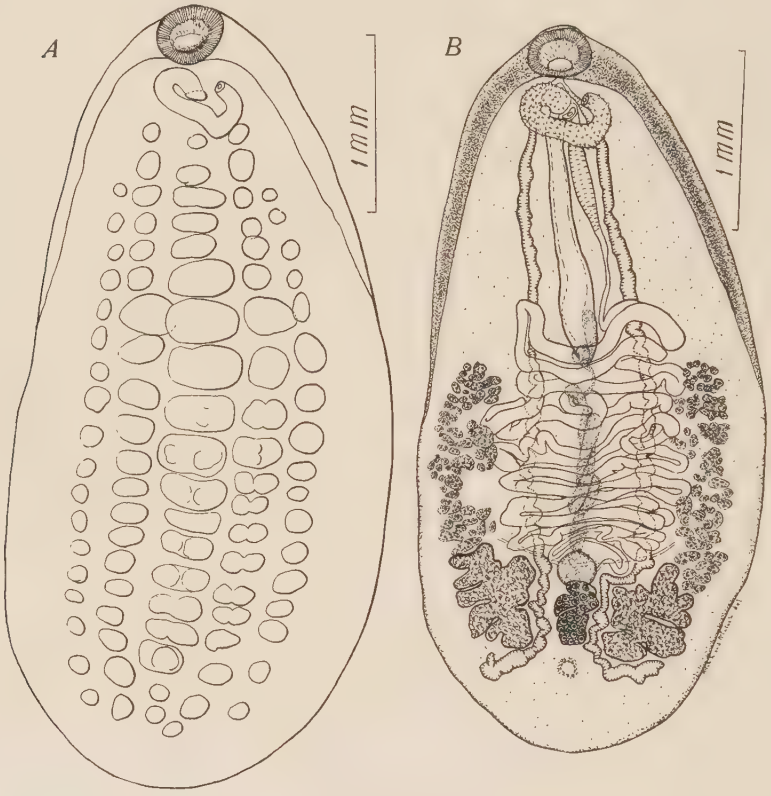

Fig. 11. *Notocotylus hassalli*, n. sp.

A—Outline of unstained specimen showing ventral glands. B—Complete specimen showing detail structure, ventral aspect.

Notocotylus hassalli, n. sp.

Description.—Body oblong, 4.1 mm long by 1.95 mm wide, slightly attenuated anteriorly (fig. 11); dorsal surface convex, ventral surface concave; lateral margins in anterior region recurved ventrally. Cuticle, especially on ventral surface of preequatorial region, closely beset with minute spines. Ventral surface with 5 rows of protrusible glands; mesal row with 19 glands, paramesal rows each with 20 glands, and lateral rows with 17 and 18 glands, respectively; glands in central region of body largest; the glands decrease in size gradually toward margins and extremities of body (fig. 11A). Oral sucker 350 by 400μ; esophagus as in other species of the genus; intestinal ceca with slight rugae, terminal portions of ceca passing between the testes and ending blindly immediately posterior to testes. Excretory pore median and dorsal, immediately posterior to ovary. Testes 600μ long by 475μ wide, lobed, extracecal, in posterior part of body. Vasa efferentia apparently short; seminal vesicle convoluted, well developed, beginning just anterior to level of testes, and extending along median line to cirrus sac. Cirrus sac 1.45 mm long by 200μ in maximum width; cirrus long (fig. 12), projecting

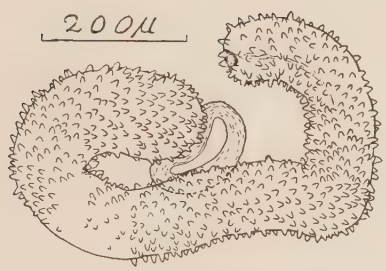

FIG. 12. *Notocotylus hassalli*, n. sp. Cirrus showing spine-like protuberances.

1.15 mm, armed with numerous spine-like conical protuberances. Genital pores near level of intestinal bifurcation; male genital pore apparently immediately anterior to female genital pore, the latter surrounded by a well developed sphincter. Ovary lobed, 387μ long by 237μ wide, intercecal, in zone of testes. Mehlis' gland well developed, preovarial. Uterus with 10 or 12 transverse loops which extend laterally slightly beyond margin of intestinal ceca; metraterm well defined, muscular, 725μ long by about 100μ in maximum width. Vitellaria extracecal, consisting of numerous follicles arranged more or less in irregularly placed clusters instead of in linear series and extending from level of anterior margins of testes to level of base of cirrus sac. Eggs with a long filament at each pole, 17 to 17.5μ long by 10 to 11.5μ wide exclusive of polar filaments.

Habitat.—Cecum of *Microtus pennsylvanicus pennsylvanicus.*

Locality.—United States (Piscataway, Maryland, and Falls Church, Virginia).

Type.—U. S. N. M. Helm. Coll. No. 40117.

Remarks.—This is the 2nd species of a notocotylid to be described as having 5 rows of protrusible glands on the ventral surface. This character alone will separate *Notocotylus hassalli* from other species of the genus with the exception of *N. quinqueseriale* Barker and Laughlin, 1911. From the latter, *N. hassalli* differs mostly in the number and arrangement of the vitelline follicles. The follicles are grouped in clusters and the clusters are larger and consist of more follicles in *N. hassalli* than in *N. quinqueseriale;* the follicles in the latter species tend to be in a more nearly linear series than in the former. The presence of spines in *N. hassalli* will serve as an additional character in distinguishing the 2 species.

In addition to the type specimen on which the description is based, 2 other specimens from meadow mice have been examined. One of these, U. S. N. M. Helm. Coll. No. 24599, catalogued as *N. quinqueseriale* from *Microtus pennsylvanicus pennsylvanicus* was collected at Falls Church, Virginia, on November 29, 1920, by Dr. E. A. Chapin. The other, U. S. N. M. Helm. Coll., No. 5773, is from the material reported by Stiles and Hassall (1894, Vet. Mag., Phila. 1:245-253) as *Monostoma* sp. from *Arvicola riparius* (=*Microtus p. pennsylvanicus*), which Harrah (1922, Ill. Biol. Mon. 7, No. 3) regarded as *Notocotylus quinqueseriale;* this specimen was collected by Dr. Albert Hassall on October 31, 1892. These 2 specimens appear to be identical with the type of *N. hassalli.*

On account of the differences noted, which appear to be fairly constant in the 3 specimens examined, the fluke from the meadow mouse is regarded as distinct from *Notocotylus quinqueseriale.* The latter apparently occurs as an adult only in the muskrat, *Ondatra zibethica.*

A new variety of *Alloionema* (Nematoda: Diplogasteridae), with a note on the genus. B. G. CHITWOOD and ALLEN MCINTOSH.

The genus *Alloionema* Schneider, 1859, has not been satisfactorily placed systematically in relation to other nematodes. This genus is particularly interesting because the alternation of generations described by both Schneider (1859, Ztschr. Wiss. Zool., 10:176-178) and Claus (1868, Schrift. d. Gesellsch. z. Beford. d. ges. Naturw. zu Marburg, Suppl., Heft 3, 24 pp.; 3 pls.) is similar to that of *Strongyloides.* The writers have recently had an opportunity to study a member of this genus; it differs only in minor respects from the genotype, *A. appendiculatum* Schneider, 1859, of which it is regarded as a new variety.

Alloionema appendiculatum var. *dubia*, n. var.

Description.—Oral opening hexagonal, lips absent; 6 cephalic papillae (? internal circle); amphids pore-like, slightly dorsal to the lateral papillae. Stoma more or less infundibuliform, varying with the state of dilation. Esophagus 136 to 200μ long, consisting of 3 parts: A corpus 91 to 110μ long by 16 to 20μ wide in anterior part and 23 to 24μ wide in posterior part; an isthmus 40 to 47μ long by 15 to 16μ wide; and a bulb 40 to 47μ long by 30μ wide, valve greatly reduced,

bulb muscular. Nerve ring variable in position, anterior or posterior to base of esophagus, according to state of contraction of body wall. Excretory pore about 30 to 50μ posterior to nerve ring; excretory system H-shaped.

Male 954μ to 1.0 mm long by 55 to 60μ wide. Cloacal orifice 36 to 46μ from posterior extremity. Spicules 36 to 46μ long. Genital papillae as shown in figure 13D. Testis single, reflexed.

Female 1.4 to 1.65 mm long by 100 to 110μ wide. Vulva 740 to 900μ from anterior extremity; uteri divergent; ovaries reflexed at about 370 and 350μ, respectively, from extremities. Eggs 50 to 60μ long by 44 to 50μ wide; 30 to 40 in number. Anus 100μ from posterior extremity; tail conical, very slightly attenuated.

Habitat.—Musculature of foot and in tentacles of *Succinea avara.*

Locality.—United States (Piscataway Swamp, near Piscataway, Maryland).

Type specimens.—U. S. N. M. Helm. Coll. No. 40037.

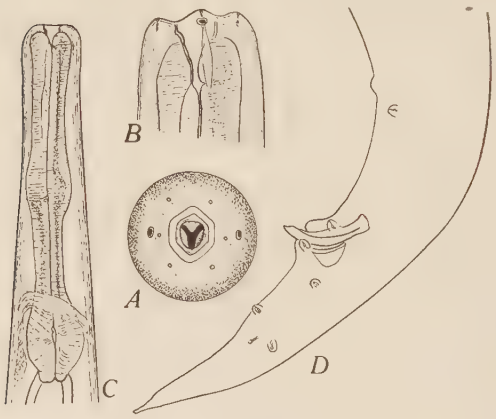

Fig. 13. *Alloionema appendiculatum* var. *dubia*, n. var. A—Head, *en face* view. B—Head, lateral view. C—Esophageal region. D—Tail of male, lateral view.

Both larvae and adults were found in the snails examined. The larvae differ from those of *A. appendiculatum* in the absence of the "appendages," the nature of which is unknown. The parasitic adults differ from *A. appendiculatum* in being much smaller in size and in that the female produces fewer eggs than does *A. appendiculatum.* An attempt to culture the material and obtain a free-living generation was unsuccessful.

Alloionema appears to be somewhat intermediate between *Rhabditophanes* and *Strongyloides.* It differs from the latter genus in that less extensive changes have taken place in the esophagus of the parasitic generation, and in the absence of lips, *Strongyloides* having 2 lips; *Rhabditophanes* has 6 indistinct lips or none. It differs from *Rhabditophanes* in the form of the stoma, in the shape of the esophagus, and in the existence of an alteration of generations.

The genera *Alloionema* and *Rhabditophanes,* together with *Cheilobus* and possibly *Turbatrix, Seleneella,* and *Macrolaimus,* appear to comprise a group related most closely to the Diplogasterinae but showing some affinities with the Cephalobinae. For this group the subfamily Alloionematinae is proposed. The subfamily is placed in the family Diplogasteridae, differing from the Diplogasterinae in the presence of a valvulated bulb.

From this study of *Alloionema,* it appears likely that *Strongyloides* may have arisen from *Rhabditophanes* through an organism similar to *Alloionema,* while *Rhabdias* appears to have arisen directly from *Rhabditis.* On this assumption and for other reasons, *Strongyloides* should be placed in a separate family for which the name Strongyloididae is proposed.

Strongyloididae, new family

Diagnosis.—Rhabditoidea: Oral opening surrounded by 2 lateral lips each bearing 2 submedian papillae and an amphid. *Free-living generation* with short, more or less infundibuliform stoma; mesostom surrounded by esophageal tissue forming a vestibule. Esophagus with thick corpus, precorpus almost as wide as postcorpus, isthmus, and valvulated bulb. Male with 1 testis; spicules equal, arcuate; gubernaculum present; caudal alae absent. Genital papillae distributed as in *Alloionema;* medioventral preanal papillae present. Female with uteri divergent, ovaries reflexed. *Parasitic generation* with stoma greatly reduced. Esophagus long and narrow, regions not grossly distinguishable. Males rare. Females with reproductive system similar to that of free-living generation.

Type genus.—*Strongyloides* Grassi, 1879.

***Dicelis nira*, new species (Nematoda: Drilonematidae).** B. G. Chitwood and John T. Lucker.

Nematodes of the family Drilonematidae, parasitic in earthworms, have not been recorded from North America. Recently one of us (J. T. L.) has had occasion to examine earthworms for other parasites, and incidentally discovered a species of the genus *Dicelus* which appeared to be new; for this species the name *Dicelis nira* is proposed. These nematodes were found in about 10 percent of the earthworms collected in a single locality.

Dicelis nira, n. sp.

Description.—Head bluntly rounded, oral opening rounded, surrounded by 8 papillae, apparently of the external circle, and 2 lateral oval amphids. Stoma extremely indistinct. Esophagus clavate, 132 to 136μ long by 18 to 22μ wide in male, and 137 to 146μ long by 20 to 32μ wide in female.

Male 1.43 to 1.73 mm long by 70 to 82μ wide. Testis single, extending to within about 385μ of anterior extremity and there reflexed posteriad. Cloacal orifice 130 to 200μ from posterior extremity. Genital papillae consisting of 6 pairs, 3 or 4 preanal, 1 adanal, and 1 or 2 postanal. Spicules 60 to 80μ long; gubernaculum 31 to 36μ long.

Female 2.18 to 3.2 mm long by 120 to 145μ wide. Vulva 1.08 to 1.5 mm from anterior extremity; anterior uterus extending nearly to base of esophagus, oviduct directed posteriad, its ovary anterior to anus, much twisted; posterior uterus sac-like, short, its ovary absent. Eggs numerous (about 25 to 30), thin shelled, 61 to 76μ long by 28 to 33μ wide.

Host.—*Helodrilus caliginosus.*

Location.—Gonads.

Locality.—United States (Beltsville, Maryland).

Type specimens.—U. S. N. M. Helm. Coll. No. 39510.

Dicelis nira differs from *D. pleurochaetae* Beddard, 1883, in that the tail is thick and not attenuated and there is no "tooth" projecting from the head in the former species, while the tail is thin and attenuated and a "tooth" is present in the latter species. *D. nira* differs from *D. filaria* Dujardin, 1845, in the contour of the tail which bears a distal conoid process (fig. 14B) in both sexes, and in the characters of the eggs which are longer and narrower in *D. nira* than in *D. filaria;* the egg shell is smooth in the former species and rugose in the latter.

Fig. 14. *Dicelis nira*, n. sp.
A—Head, *en face* view. B—Tail of male, lateral view. C—Spicule and gubernaculum. D—Cross section of male in region of excretory sinus. E—Cross section of male posterior to excretory sinus.

Sections were made in order better to observe the anatomy which is little known for the group. The following notes were made: The intestine of *D. nira* is few-celled, 2 to 6 cells in circumference; 3 rectal glands open into the posterior gut just behind the intestinorectal valve (not illustrated). The "suckers" or caudal discs at the sides of the tail are apparently phasmids. Each consists of a large unicellular gland, a short duct opening through a small pore surrounded by thickened cuticle, and a group of nerve cells which probably forms a sensilla. The excretory system is apparently U-shaped; the sinus contains at least 1 nucleus in its posterior wall on the left side; another nucleus in the anterior wall of the sinus may also belong to the excretory system. Both the sinus and the ducts are thick-walled and the protoplasm vesiculate.

The incidence of worm parasites in swine in the southern United States.

L. A. Spindler.

INTRODUCTION

Although extensive losses are said to result from the infestation of swine with various species of worm parasites, comparatively little data of a complete and extensive sort are available in the United States regarding the incidence and the degree of infestations with the various common species of helminths which occur in these host animals. Nighbert and Connelly (1933, U. S. Dept. Agric. Technical Bull. 374: 1-14) reported the average number of ascarids, thorn-headed worms, nodular worms, whipworms and hookworms per animal in 592 swine, and the incidence of kidney worms in 2192 swine which they examined post mortem in Colquitt County, Georgia. The data recorded by these investigators are rather incomplete, since they do not record the number of animals infested with the above mentioned intestinal helminths, and present no data on 5 species of helminths which are commonly found in hogs in that region, namely *Ascarops strongylina, Physocephalus sexalatus, Hyostrongylus rubidus, Strongyloides ransomi and Gongylonema pulchrum.*

In a series of post-mortem examinations made by the writer on swine from the southeastern portion of the United States, principally from southern Georgia and northern Florida, extensive data were obtained on the extent of the worm infestations in hogs. Portions of the data with respect to nodular worms have already been reported (Spindler, 1933, Jour. Agric. Res., 46: 531-542; 1933, N. Am. Vet., 14: 37-44), and these data also are included in this paper in order to present a complete picture of the extent of worm infestations in these swine.

RESULTS OF POST-MORTEM EXAMINATIONS

From September 1929 to August 1931, complete post-mortem examinations for worm parasites were made of 348 swine; the youngest of these animals was 4 months old and the oldest several years old; most of them were from 6 to 12 months old. In addition, post-mortem examinations were made of 19 other swine (adults) for nodular worms and whipworms, and of 1075 additional swine for kidney worms alone. Due to the length of time required for the collection, identification and counting of the various species of nodular worms and lungworms, only the females were counted. Likewise, due to the difficulty of recovering all the specimens of *Strongyloides* and kidney worms from the infested animals, no attempt was made to determine the extent of the infestations with these species. In the case of the remaining species of worms considered in this paper both males and females were identified and counted.

Table showing the incidence and intensity of helminth infestations in hogs in the southern United States

Parasite	Animals examined post mortem	Percentage infested	Average number of worms per positive animal	Range in numbers of worms in individual animals
Ascaris suum	348	74	8	1 to 176
Macracanthorhynchus hirudinaceus	348	25	3	1 to 20
Crassisoma urosubulatum	348	11	7	1 to 49
Gongylonema pulchrum	348	14	3	1 to 11
Metastrongylus elongatus	348	69	24*	1 to 167
Choerostrongylus pudendotectus	348	50	17*	1 to 97
Metastrongylus salmi	348	12	2*	1 to 18
Oesophagostomum longicaudum	367	97	126*	1 to 1820
Oesophagostomum dentatum	367	81	76*	1 to 725
Oesophagostomum brevicaudum	367	38	36*	1 to 582
Ascarops strongylina	348	53	18	1 to 98
Physocephalus sexalatus	348	47	21	1 to 235
Hyostrongylus rubidus	348	15	29	2 to 164
Trichuris suis	367	23	3	1 to 14
Strongyloides ransomi	348	26	No count	No count
Stephanurus dentatus (in kidneys)	1423	51	No count	No count
Stephanurus dentatus (in livers)	1423	88	No count	No count

*Females only.

The data presented in the table show the number of swine of all ages examined, the percentage of animals infested with the various species, and the range and mean of the infestations for each species. No attempt will be made to present a detailed discussion of the data pertaining to each parasite as the table is considered sufficiently explanatory. However, some of the outstanding points with regard to the most common forms, namely nodular worms, kidney worms, ascarids, lungworms and stomach worms will be considered in the order named.

Nodular worms.—The data show that nodular worms were the most prevalent from the standpoint of incidence. As shown in the table, the mean infestations varied from 36 female worms per infested animal in the case of *Oesophagostomum brevicaudum*, to 126 female worms per infested animal in the case of *O. longicaudum*. Since approximately equal numbers of male and female *Oesophagostomum* occur in swine, the indicated average infestation for each species can be assumed to be approximately double the average given for female worms. Consequently it can be seen from the data that the probable average number of male and female *Oesophagostomum* spp. found in each animal was in the neighborhood of 400 to 500 worms. These infestations are much heavier than those reported by Nighbert and Connelly who recorded 10.57 male and female worms per animal. It is evident in the light of the data presented that large numbers of nodular worms were present in the hogs examined, since the majority of these host animals were infested with 2 species and in many cases 3 species, of this genus. Moreover, the number of worms recovered post mortem in these examinations represents only a small portion of the nodular worms actually harbored, since many nodules, each containing a nodular worm larva, were present in the mucosa of the colons of the infested animals. In many pigs, hundreds of such nodules were present.

Kidney worms (*Stephanurus dentatus*).—While probably of greatest economic importance among the helminths which parasitize swine in the South, this nematode was, from the standpoint of the incidence of infestation, second in rank; 88 percent of the livers examined and 51 percent of the kidneys, one or both, contained these worms.

Ascaris.—From the standpoint of numbers of animals infested, the third most common parasite found was the large roundworm, *Ascaris suum*. Although 74 percent of the hogs examined were infested with this worm, and the infestations varied from 1 to 176 worms per animal, the mean infestation, as shown in the table, was 8 worms per animal. This figure takes no account of the larval forms of this parasite which may have been present in the livers and lungs.

Lungworms.—Of the heteroxenous helminths, lungworms were the most widespread; *Metastrongylus elongatus* was the most common species, occurring in 69 percent of the animals examined, while *M. salmi* was the least common, occurring in 12 percent of the hogs examined; *Choerostrongylus pudendotectus* occurred in 50 percent of the hogs examined. The prevalence of lungworms can be explained by the fact that in the region where this study was made, hogs are often kept in low-lying pastures where earthworms, the intermediate hosts of swine lungworms, are common.

Stomach worms.—As shown in the table, the incidences and mean infestations with the heteroxenous stomach worms, *Ascarops strongylina* and *Physocephalus sexalatus*, were approximately equal. *Hyostrongylus rubidus*, the monoxenous stomach worm of swine, was less common than the other two species.

DISTRIBUTION OF PARASITES IN THE SWINE EXAMINED

In this series of examinations it was found that the individual swine examined were infested with from 2 to 15 species of worms; 92 percent of the hogs were infested with from 4 to 11 species; 19 percent harbored 6 species of worms per animal. None of the swine examined were infested with all the 16 species of worms commonly found in hogs of the region where this work was done; on the other hand, none of the animals examined were entirely free from worms.

SUMMARY

The results of a series of post-mortem examinations of swine for worm parasites are given; these swine were, for the most part, from southern Georgia and northern Florida.

Listed in the order of their incidence the most common worm parasites found were *Oesophagostomum* spp., *Stephanurus dentatus, Metastrongylus* spp., *Choerostrongylus pudendotectus, Ascarops strongylina, Physocephalus sexalatus,* and *Macracanthorhynchus hirudinaceus.*

The majority of the hogs examined were parasitized with from 4 to 11 species of worms; none of the animals were infested with all the 16 species considered in this paper; on the other hand, none of the animals examined were entirely free of worms.

Effect of copper sulphate on infective larvae of the nematodes *Stephanurus dentatus* (Stephanuridae) and *Oesophagostomum* spp. (Strongylidae). L. A. Spindler.

De Jesus (1933, Phil. Agric., 21: 677-694) recommended that hog lots infested with larvae of *Stephanurus dentatus* be sprayed with an aqueous solution of copper sulphate containing 1 part of copper in 5,000 parts of water in order to kill the larvae. In a test carried out by the present writer in the fall of 1933, areas of soil infested with larvae of *S. dentatus* and *Oesophagostomum* spp., were sprayed weekly, for a period of 8 weeks, with a 1 percent aqueous solution of copper sulphate, at the rate of 7 cc of solution per square foot of soil; the solution was applied by means of a hand sprayer. Examinations of the soil for *Stephanurus* and *Oesophagostomum* larvae were made 3 times each week by means of the Baermann apparatus. Larvae of both species were recovered in all the examinations made; no diminution in the numbers of larvae recovered was observed throughout the test.

In a second test carried out in the spring of 1934, areas of soil infested with the same species of larvae were sprayed daily for a period of 2 weeks, by means of a hand sprayer, with a 1 percent aqueous solution of copper sulphate at the rate of 15 cc of solution per square foot of soil. Examinations of these areas for larvae were made daily by means of the Baermann apparatus with positive results. As in the previous test, no diminution in the number of larvae recovered in the examinations was noted throughout this test.

As a further test of the effect of an aqueous solution of copper sulphate on kidney worm and nodular worm larvae on soil, a large number of infective larvae of these species was placed on soil in a glass dish. The soil was sprayed on each of 3 succeeding days with a 1 percent solution of copper sulphate at the rate of 15 cc of solution per square foot of soil. Examinations, by means of the Baermann apparatus, showed that the copper sulphate spray did not kill the larvae, as the number of larvae of both species recovered in the examinations remained approximately the same throughout the test.

Observations on stephanofilariasis in cattle. G. Dikmans.

During a recent field trip, clinical and microscopical evidence was obtained which indicates that infestation with *Stephanofilaria stilesi* Chitwood, 1934, is fairly common in cattle in South Dakota, Colorado, Wyoming and Nebraska. Unconfirmed reports from field workers indicate that it occurs also in Montana, and presumptive evidence obtained in one of the abattoirs in Denver, Colorado, indicates its presence in cattle in New Mexico.

All the lesions observed so far have been found on the ventral surface of the body in and adjacent to the midline, either anterior or posterior to the navel. Some small lesions have been observed in the groin and some on the anterior surface and tip of the scrotum.

The lesions vary considerably in size ranging from less than 1 inch to about 6 inches in diameter. They differ also greatly in appearance, some of them ap-

pearing as small areas, from ¼ to ½ inch in diameter, not altogether hairless but marked with spots of dried blood and serum, others appearing as areas about 1 inch in diameter, hairless and moist with blood and serum. This blood and serum may be dried, forming scabs and crusts. Judging from clinical appearance, such areas may heal without spreading, in which case an area of smooth, hairless and thickened skin is observed. One animal showed a number of such apparently healed lesions extending linearly for a distance of about 15 to 18 inches along the midline both anterior and posterior to the navel. In other cases the initial lesion apparently extends peripherally, in which case an area about 2 to 3 inches in diameter, with a hairless, wrinkled and thickened center and a periphery marked with numerous small hemorrhagic spots, may be observed. In still other cases the area involved, which may be several inches in diameter, appears greyish and is covered with a heavy dry crust marked with cracks and crevices. In some cases this crust, instead of being dry and greyish in appearance, is deep red in color and the cracks appear moist and bloody.

The lesions occur on both bulls and cows, and while most of the animals in the range herds which came under the writer's observation were Herefords, the lesions have also been observed in cattle of other breeds both in the abattoirs at Denver and Omaha and on farms. While most of the lesions have been observed in mature animals, fairly extensive lesions have also been noted in animals 2 years old and younger.

Up to the present time this disease has been observed in cattle only, so far as definitely diagnosed cases are concerned. While in northern Nebraska it was reported to the writer that a condition similar in clinical appearance had been noted in a buffalo. This report could not be verified but the buffalos observed in the Custer State Park, South Dakota, showed no visible evidence of infestation.

The disease can be diagnosed with reasonable certainty on the basis of the location and gross appearance of the lesions. Such presumptive diagnosis can be confirmed by finding either adult nematodes, pieces of adult nematodes, or larvae either free or enclosed in a vitelline membrane, in scrapings made from the lesions. For the purpose of skin scrapings active lesions only should be selected, an active lesion being interpreted as a lesion showing exudation of blood and serum either moist or dried in the form of scabs or crusts. All scabs must be removed from the area prior to scraping and scrapings must be deep enough to draw blood.

At the present time, nothing can be said with any degree of certainty as to the method by which infection is acquired and spread. Basing our opinion on the identity of the nematode found in the lesions, as at present established, it is probable that an intermediate host is necessary in the life cycle, and as possible intermediate hosts the insects found on infested animals, and especially those found on the lesions themselves, come in for first consideration. During the field survey conducted by the writer, the only insects found on animals showing clinical evidence of infestation with *Stephanofilaria stilesi* were horn flies. On warm days these flies were found to congregate on the lesions in large numbers. Owners of affected dairy herds stated that the condition is greatly aggravated during hot, moist and humid weather, and these dairymen attributed the lesions to fly infestation. Whether this fly or any other insect is an intermediate host of this nematode, can only be determined by carefully conducted experiments.

The nematode genera *Hystrignathus* Leidy, *Lepidonema* Cobb and *Artigasia*, n.g. (Thelastomatidae). J. R. CHRISTIE.

The genus *Hystrignathus* was proposed by Leidy (1850, Proc. Acad. Nat. Sc. Phila., 5: 100-102) who placed in it 1 species, *H. rigidus*, from *Passalus cornutus* collected near Philadelphia, Pa. *Xyo histrix* Cobb, 1898 (Agric. Gaz. N. South Wales, 9: 296-321) from a species of beetle (*Passalus*) collected in New South Wales, Australia, was transferred to the genus *Hystrignathus*, where it obviously belongs, by Johnston (1912, Proc. Roy. Soc. Queensland, 24: 63-91). Artigas (1926, Bol. Biol. 1: 1-13; 1928, Bol. Biol. 12: 71-75) described 9 nematode parasites of passalid beetles, "Coleopteros passalideos," from Brazil

and assigned these worms to the genus *Hystrignathus*. Artigas (1926) gave a generic diagnosis for both males and females but his specific descriptions dealt with females only. He was apparently unable to assign males to the proper females on a basis of morphological characters.

The genus *Lepidonema* was proposed by Cobb (1898) for a parasite, *L. bifurcata*, of an unidentified insect larva, also from Australia. Artigas (1928) has placed in this genus a second species, *L. tarda*, from beetles, "Coleopteros passalideos," collected in Brazil.

In his generic diagnosis, Artigas (1926) wrote, "aparelho reproductor monodelpho e prodelpho." In his later paper (1928) he stated that species of *Lepidonema* have 2 ovaries while those of *Hystrignathus* have 1, and this is the principal character by which he distinguished the 2 genera. The 9 species which Artigas placed in *Hystrignathus* all possess 1 ovary. However, these 2 genera cannot be thus separated since *H. rigidus*, type species of the genus, and *H. histrix* have 2 ovaries.

The writer is of the opinion that the monodelphic species do not properly belong in the genus *Hystrignathus* and proposes for them the new genus *Artigasia*.

Artigasia, n.g.

Diagnosis.—Thelastomatinae: *Male* with testis outstretched; tail short, subconical, ending in blunt terminus; provided with a dorsal, sub-cylindrical, cuticularized structure extending nearly to terminus. At least 1 pair of conspicuous preanal papillae; spicule lacking. *Female* with cervical region sometimes bearing cuticular spines; cephalic papillae unknown. Stoma (vestibule, according to Artigas) often considerably elongated. Esophageal corpus subcylindrical, isthmus distinct. Tail conical to attenuated, never filiform. Vulva at or slightly posterior to middle of body; reproductive system single.

Type species.—*Artigasia leidyi* (Artigas, 1926) n. comb.

Other species are as follows: *Artigasia longicollis* (Artigas, 1926), *A. elegans* (Artigas, 1926), *A. vesiculosa* (Artigas, 1926), *A. hoehnei* (Artigas, 1926), *A. similis* (Artigas, 1926), *A. longicaudata* (Artigas, 1926), *A. inermis* (Artigas, 1926), and *A. polita* (Artigas, 1928), all new combinations.

Genus *Lepidonema* Cobb, 1898

Diagnosis.—Thelastomatinae: *Male* with character of testis unknown. Tail conical, ending in point (or bifurcated mucro); cuticle on dorsal side not markedly thickened; 3 pairs of papillae, 1 pair preanal, and 2 pairs postanal, spaced more or less equidistant; spicule present. *Female* with cervical region bearing longitudinal rows of backward pointing, cuticular "scales." Cephalic papillae unknown. Length of stoma never greatly exceeding that of head region. Esophageal corpus subcylindrical, isthmus distinct. Tail conical, sometimes bifurcated at terminus. Vulva at or slightly posterior to middle of body; reproductive system double.

Type species.—*Lepidonema bifurcata* Cobb, 1898.

Lepidonema bifurcata Cobb, 1898

♂	.5	13	21.	M	97.6	1.2 mm
	1.	2.6	3.1	3.4	1.1	
♀	5.	10.	16	"55"	95.	3.5 mm
	1.2	3.2	3.9	5.1	2.3	

Description.—(Summarized from unpublished notes by Dr. N. A. Cobb). *Male* cuticle with faint transverse striae, cuticular "scales" lacking. Head region (or lip region) not distinctly set off. Tail irregularly conoid and apparently ending in bifurcate mucro. Papillae arranged as follows: Preanal—1 pair, large, mammiform, submedian, removed from anus a distance equal to

length of tail; postanal—1 pair, subventral, near anus; 1 pair, subventral, near beginning of posterior third of tail. Spicule straight, linear, 2/3 as long as tail. *Female* with cuticular markings (transverse?) 2.4 to 2.8μ apart, visible only on anterior part of body. Cervical region bearing about 12 longitudinal rows of "scales," of which 1 row is located on either side of each lateral line; "scales" largest near head. Head region (or lip region) set off by constriction forming distinct "button" at anterior end. Stoma simple, prismoidal, ¼ as wide as head and twice as deep as wide. Esophageal corpus subcylindrical; isthmus distinct, half as wide as base of corpus; bulb subspheroidal, 1/3 as wide as corresponding body region. Nerve ring near base of corpus, excretory pore opposite nerve ring. Rectum 2½ to 3 times as long as anal body-diameter. Anus rather inconspicuous; tail irregularly conoid, ending in a 2-pointed or minutely bifurcated terminus. Vulva rather large, slightly elevated; vagina directed anteriad. Ovaries 2, extending at least halfway to anus and esophageal bulb, respectively, then reflexed, extending past vulva and often again reflexed for a short distance. Eggs 106 to 120μ long by 40 to 48μ wide, rounded at one end and bluntly pointed at the other, deposited after the first stages of segmentation.

Host.—Larva of an insect (unidentified).

Locality.—Australia (Moss Vale, New South Wales).

The female of *Lepidonema bifurcata* very closely resembles females of *Hystrignathus* and the validity of the former genus rests entirely with the male. This is an unfortunate situation as the danger of error in matching males with the proper females is all too well known by those who have worked with the thelastomatids. Likewise the female of *L. tarda* closely resembles females of *Hystrignathus*. We are informed that the male of *L. tarda* was secured but the material accidentally destroyed and no description was given. Unless the male of this species resembles the male of *L. bifurcata*, the writer regards it as probable that *L. tarda* also should be placed in the genus *Hystrignathus*.

Genus *Hystrignathus* Leidy, 1850

Synonyms.—*Anguillula* Diesing, 1861; *Xyo* Cobb, 1898.

Diagnosis.—Thelastomatinae: *Male* with testis outstretched. Tail short, subconical, ending in blunt terminus. Cuticle on dorsal side markedly thickened; with at least 1 pair of conspicuous preanal papillae and 1 pair of smaller postanal papillae; spicule lacking. *Female* with cervical region bearing backward-pointing cuticular spines. Cephalic papillae of external circle typically papilloid in character. Length of stoma never greatly exceeding that of head region. Esophageal corpus subcylindrical, isthmus distinct. Tail conical, ending in point; bifurcated in certain larval stages. Vulva at or slightly posterior to middle of body; reproductive system double.

Type species.—*Hystrignathus rigidus* Leidy, 1850.

Hystrignathus rigidus Leidy, 1850

Synonym.—*Anguillula* (*Hystrignathus*) *rigidus* (Leidy, 1850) Diesing, 1861.

Description.—*Male*, identity questionable. *Female* (figs. 15A and 16) 2.13 to 4 mm long by 170 to 200μ wide. Body reaching greatest width between base of esophagus and excretory pore. First annule back of head 12μ wide and without spines, not distinctly wider than succeeding annules, these increasing gradually in width posteriad and becoming less distinct. Beginning on second annule and extending to region slightly in front of excretory pore, body bearing 16 longitudinal rows of sharp, backward-pointing, cuticular spines, these spines, 8μ long on the 2nd annule, reaching a length of 18μ on about the 5th and 6th annules, then decreasing in size posteriad and ending on about the 106th annule as minute points. Head 10μ long by 34μ wide, shaped like a truncate cone; external circle of 8 papillae tending to be arranged in pairs; ventro-lateral papillae absent; papillae of internal circle apparently absent. Stoma subcylindrical, not sharply differentiated from lumen of esophagus; unarmed. Esophagus 650 to 670μ long, corpus subcylindrical. A specimen 4.2 mm long gave the following measurements: Corpus 507μ long by 30μ wide at anterior end and 50μ wide at base; isthmus 63μ long by 24μ wide; bulb 85μ long by 70μ

wide. Nerve ring 250 to 340μ from anterior end of body. Excretory pore 1.18 mm from anterior end of body. Intestine with a somewhat elongate, oval, anterior dilation. Anus small, inconspicuous, 470 to 520μ from caudal extremity. Tail conical, not sharply differentiated from remainder of body. Vulva 1.5 to 2 mm from anterior end of body, small, not salient; vagina directed anteriad from vulva; 2 ovaries. Eggs ellipsoidal, 100 to 110μ long by 38 to 44μ wide, unsegmented at deposition.

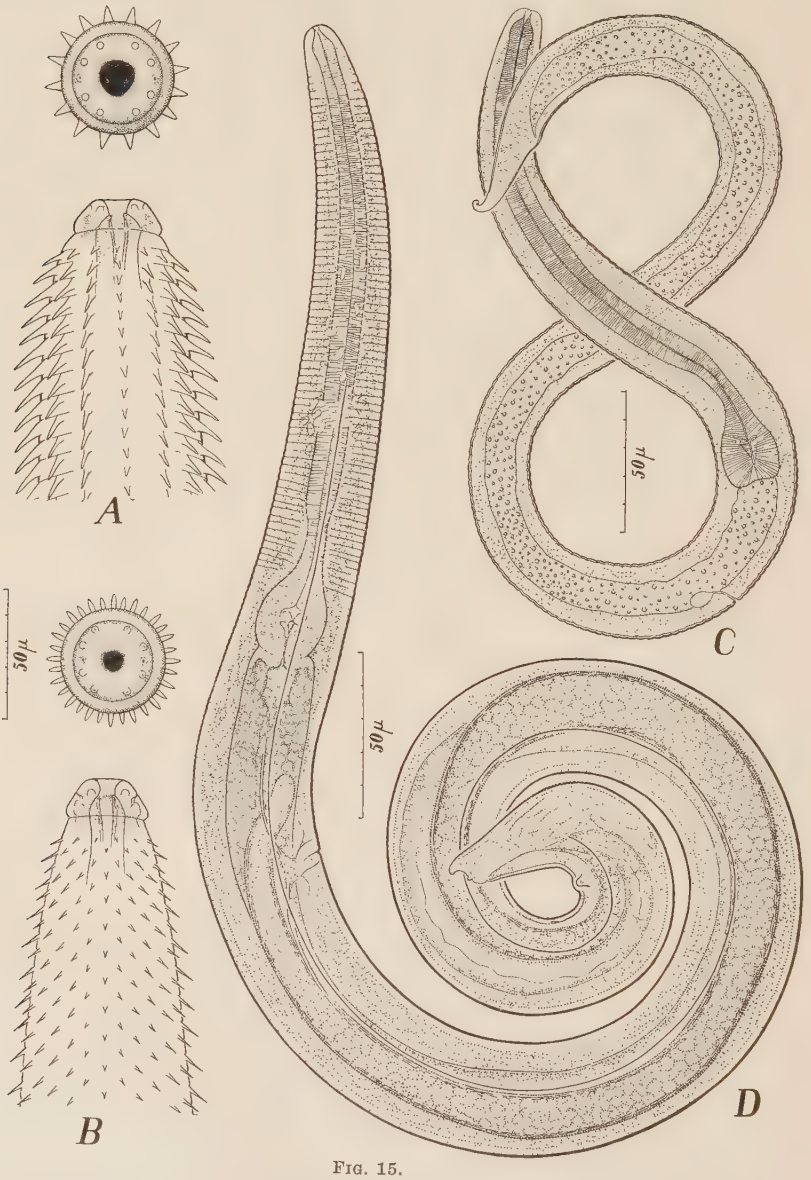

Fig. 15.

A—*Hystrignathus rigidus*, adult female, anterior end, dorso-ventral view and *en face* view of head. B—*H. histrix*, adult female, anterior end, dorso-ventral view, and *en face* view of head. C—*H. ?rigidus*, larval male. D—*H. ?rigidus*, adult male.

Host.—Passalus cornutus.

Location.—Intestine.

Distribution.—United States (Pennsylvania, Virginia, Maryland, Louisiana and Illinois).

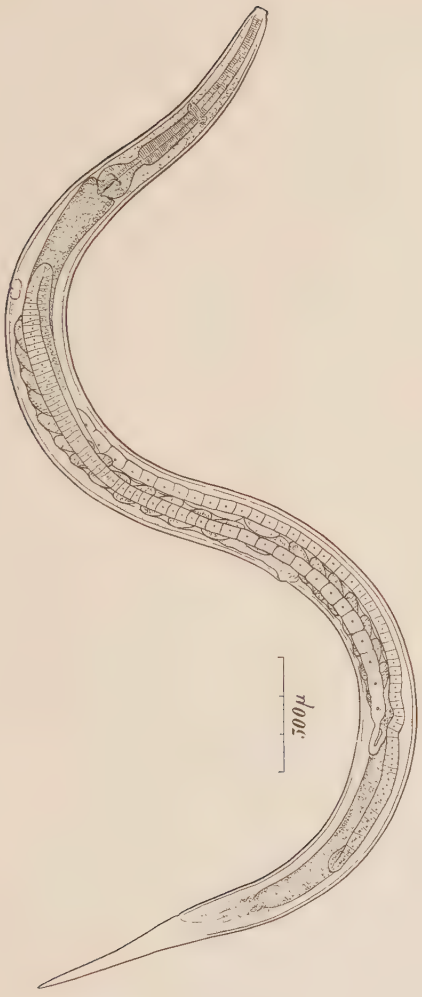

FIG. 16.

Hystrignathus rigidus, adult female; cervical spines omitted.

Hystrignathus histrix (Cobb, 1898) Johnston, 1912

Synonym. — *Xyo histrix* Cobb, 1898.

Description.—Male, identity questionable. *Female* (fig. 15B) characters as in *H. rigidus* but with the following differences: Cuticle without distinct annules, bearing 32 longitudinal rows of backward-pointing spines beginning about 8μ back of head and extending nearly to region of excretory pore; these spines arranged in obscure transverse rows and the members of each transverse row alternating with those of the 2 adjacent transverse rows, thus producing oblique rows; near head, spines 4 to 5μ long, gradually increasing in length posteriad to about 10μ, then gradually decreasing and becoming minute points. Head about 15μ long by 32μ wide. Anus 250 to 390μ from caudal extremity.

Hosts.—A species of beetle (*Passalus*) and *Passalus cornutus*.

Location.—Intestine.

Distribution.—Australia (Moss Vale, New South Wales); United States (Virginia, Maryland, Louisiana and Illinois).

This species differs from *H. rigidus* primarily in the arrangement of the cervical cuticular spines. In addition the cervical region lacks distinct annules, the head is slightly narrower and longer, and the tail somewhat shorter.

The writer has examined hundreds of beetles (*Passalus cornutus*) from various parts of the United States and, when infested, they invariably harbor females of both the foregoing species. Usually males also are present. Beyond question the males belong to one or the other or both of the accompanying species of females. No means has been found, however, to separate the males into 2 species on the basis of morphological characters. There is the possibility that we are dealing, not with 2 species, but with a single, polymorphic species in which occur 2 types of females and 1 type of male. Inasmuch as both types of females have already been given specific names, it seems advisable to regard them tentatively as distinct species, and to assign the male, provisionally, to the types species, *H. rigidus*. The male (fig. 15D), may be described as follows:

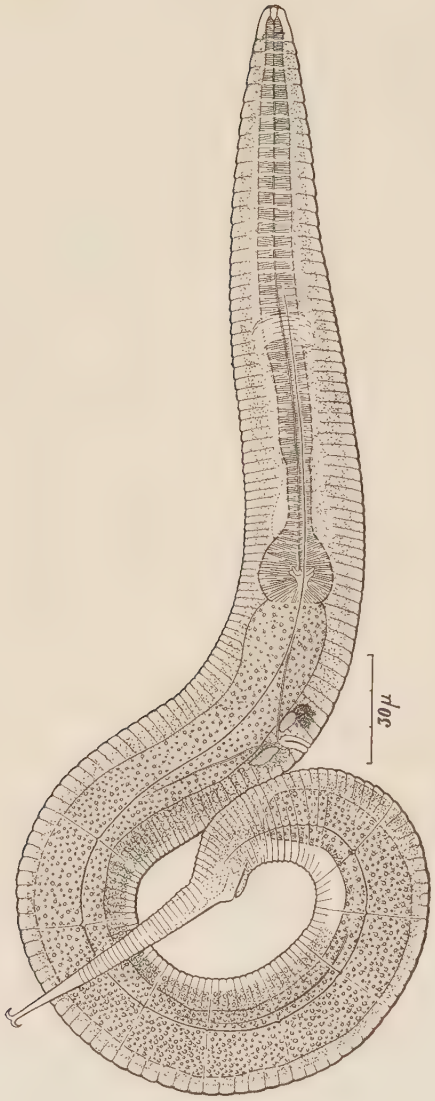

Fig. 17.
Hystrignthus ?rigidus, larval female.

Description.—Body 660 to 930μ long by 40 to 50μ wide. First 3 or 4 annules back of head region indistinct, succeeding annules about 3μ wide, decreasing gradually in width and becoming less distinct posterially. Spines lacking. Narrow but distinct lateral alae are present, extending from near nerve ring to a point slightly in front of anus. Head not set off; cephalic papillae not seen. Distinct stoma lacking. Esophagus 190 to 220μ long; corpus subcylindrical, faintly expanded near head; isthmus long; bulb piriform. A specimen 930μ long gave the following measurements: Corpus 180μ long by 8μ wide at anterior end and 11μ wide at base; isthmus 22μ long by 8μ wide; bulb 31μ long by 25μ wide. Nerve ring 110 to 140μ from anterior end of body. Excretory pore considerably posterior to base of esophagus, 250 to 295μ from anterior end of body. Intestine slightly dilated anteriorly. Anus nearly terminal, about 10μ from caudal extremity. Caudal papillae: Preanal—1 pair, moderately large, sublateral, 20μ from anus, and 1 pair, minute, subventral, on anterior lip of anus; postanal—1 pair, small, subventral, 4 to 5μ back of anus; tail ending in papilla-like projection. Spicule lacking. On dorsal side of tail a thickening of the cuticle about 25μ long and extending nearly to the terminus. Testis outstretched, blind end usually lying in front of excretory pore.

Larval females of *H. rigidus* cannot be distinguished from those of *H. histrix* until cervical spines are developed, which does not take place until after the third molt. It is interesting to note that during early development, probably during either the 2nd or 3rd larval stage, or possibly during both, the body ends posteriorly in a bifurcate, anchor-shaped terminus (fig. 17). This is not present during the 4th larval stage. A fairly close relationship to *Lepidonema bifurcata* is thereby suggested, although males in the 2 genera differ considerably.

Recent records of the gizzard worm, *Acuaria anthuris* (Rudolphi, 1819) (Nematoda: Acuariidae), with observations on its life history. Eloise B. Cram.

In the past 5 years, studies in several parts of the world have enlarged our knowledge of *Acuaria anthuris*, type species of the genus *Acuaria* and previously poorly known. Comprehensive descriptions were furnished by Maplestone

(1931, Rec. Indian Mus. 33: 71-73) of specimens from *Graculus eremita* in India, and by Markowski (1933, Mèm. Acad. Polon. Sc. et Lett., Sc. Nat. 5: 44-49) of collections from several species of Corvidae in Poland. Shikobalova (1930, J. Parasitol. 16:220) made a study in the Soviet Union and concluded that *Acuaria ornata* (Gendre, 1912), originally described from the African *Corvus scapulatus,* is identical with *A. anthuris.* In the United States, Williams (1929, Univ. Calif. Pubs. Zool., 33: 69-107) described a new species, *A. nebraskensis,* from *Corvus brachyrhynchos;* Williams had available at the time specimens identified by Rudolphi as *A. anthuris,* from the Berlin Museum, host unspecified, but he did not furnish a description of Rudolphi's material and, it now being recognized that Rudolphi identified several different species as *A. anthuris,* the specific identity of the specimens examined by Williams remains in doubt. However, in view of variations included in the recent descriptions of *A. anthuris,* referred to above, the characters described for *A. nebraskensis* appear to fall within the range of *A. anthuris,* as restricted at the present time, and that species is therefore regarded as synonymous with the type species.

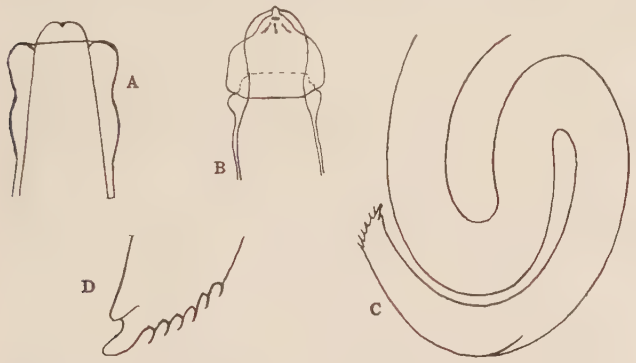

FIG. 18. *Acuaria anthuris,* 3rd-stage larva
A—Head end, optical section, dorso-ventral view, unpreserved specimen. B—Head end, lateral surface view, preserved specimen. C—Posterior portion of body. D—Tail end.

Life history experiments with specimens collected by the writer from crows, *Corvus brachyrhynchos* and *C. ossifragus,* from Maryland, identified as *A. anthuris,* led to the development of the nematode in grasshoppers (*Melanoplus femurrubrum*) and in crickets (unidentified); the 3rd-stage larvae appeared to be fully developed 28 to 30 days after the nematode eggs were fed to these orthopterans. Similar attempts to infect ground beetles (Coleoptera) were unsuccessful. Attempts to develop the adults by feeding the 3rd-stage larvae to chickens and pigeons were unsuccessful.

Characteristics of the 3rd-stage larva of *A. anthuris* are as follows: Length 1.2 to 1.4 mm Head with 2 lips; cuticle inflated posterior to lips to form collar (fig. 18, A and B). In a specimen 1.2 mm long, muscular esophagus 224μ long, and glandular esophagus 424μ long, the esophageal portion of body being thus about 13/24 of total length. Nerve ring 104μ, cervical papillae 124μ, excretory pore 144μ, from anterior end of body. Anus 152μ from tail end. Posterior end of body with reversal of curve made by anterior part of body. Tail end blunt, sloping obliquely from ventral to dorsal surface (fig. 18, C and D), bearing a row of very delicate hair-like spines, each one on a separate "step" or "shoulder," and a thumb-like papilla at dorsal end of row; at base of papilla cuticle thickened and projecting, collar-like.

As regards other species of Acuariidae, the larva of *A. anthuris* resembles much more closely those of the gizzard worms, *Cheilospirura hamulosa* and *C. spinosa,* developed also in grasshoppers, than that of the proventricular worm, *Dispharynx spiralis,* which develops in isopods (sow bugs and pill bugs). It does not resemble *Filaria gammari,* a larval nematode from the amphipod, *Gammarus pulex,* which when described by Linstow (1892, Arch. Mikr. Anat., 39: 325) was said possibly to be *A. anthuris;* Linstow's description does not conform with that of any known 3rd-stage larva of a bird parasite.

Orthopterans and pigeons as secondary and primary hosts, respectively, for the crow stomach-worm, *Microtetrameres helix* (Nematoda: Spiruridae). Eloise B. Cram.

Eggs from adult female specimens of *Microtetrameres helix,* collected by W. E. Swales of McGill University, Canada, and sent unpreserved to the writer, were fed to arthropods and annelids. The nematodes, as 3rd-stage larvae, were recovered 26 to 68 days later from several grasshopper nymphs (*Melanoplus* spp.), 2 adult grasshoppers (*Melanoplus femurrubrum* and *M. bivittatus*), and a cockroach (*Blattella germanica*), all these orthopterans having been laboratory-reared. There were numerous specimens in the grasshoppers but only a single larva in the cockroach. Negative results were obtained with annelids (earthworms) and isopods (pillbugs).

The 3rd-stage larvae of *M. helix,* coiled in thick-walled, semi-transparent cysts chiefly among the tissues of the body cavity, less frequently in muscles of legs and head, became very active when the cysts were moved. They freed themselves quickly when the cysts were punctured and swam rapidly with a lashing motion through the water in the dissecting dish. The larvae showed the following characteristics: Length 2.28 to 2.59 mm; maximum width, near middle of body, about 80μ; head simple, with 2 small lips; mouth cavity about 20μ deep; muscular esophagus 172 to 265μ, glandular esophagus 530 to 593μ long; anus 240 to 280μ from tail end; tail slender, tapering, with a very minute, unadorned ball at its tip.

The larvae proved infective to pigeons, *Columba livia domestica;* the birds had been laboratory-reared. Members of the same lot of pigeons used in connection with other experiments and all negative for *M. helix,* served as controls. Larvae of *M. helix* of 26 days development in a grasshopper were fed to an adult pigeon; at necropsy 29 days later, 1 immature female of *M. helix* was present in a gland of the proventriculus.

Larvae of 34 days development in a grasshopper were fed to a young pigeon; at necropsy 35 days later, 7 males and 10 females of *M. helix* were present as immature adults, the females in the fundus of the glands, the males nearer the surface or on the surface of the proventriculus. The males measured about 3.9 mm long, with spicules easily discernible, 120μ and 3.12 mm long. The females, non-gravid, red in color; the body of the worm formed loose coils, modified in degree and arrangement by its movements, the spherical form assumed by the coils measuring about 800μ to 1 mm in diameter; the digestive tract was filled with black detritus.

Coexistence of adult male and female *Tetrameres* (Nematoda: Spiruridae) in proventriculus of the Florida grackle. E. E. Wehr.

The proventriculus of a Florida grackle, *Quiscalus quiscalus aglaeus,* infested with an unidentified species of the genus *Tetrameres* was sent to the Zoological Division, U. S. Bureau of Animal Industry by F. M. Uhler from Sanford, Florida. On opening the Lieberkühn glands, the writer found, with each mature female containing embryonated eggs, 1 and sometimes 2 mature males. The males were pressed closely against and, in some cases, embedded slightly in the body wall of the female. The above observation suggests that the two sexes of this species of nematode may cohabit throughout their entire parasitic existence.

Cram (1931, U. S. Dept. Agric. Technical Bull. 227) stated, in connection with a discussion of the life history of *Tetrameres americana,* that the young males were found on the surface of the mucosa prior to the 16th day after experimental infestation of young chicks with the larvae of this species obtained from experimentally infected grasshoppers. Between the 16th and 19th days, however, the males were present in the glands containing the females, as evidenced by the fact that some of the males were expelled with the females on squeezing the glands. After the 19th day, the males were again collected from the surface of the mucosa. The entrance of the males into the glands was, no doubt, solely for the purpose of mating, after which they returned to the lumen of the proventriculus.

Egg production by *Nematodirus* spp. (Trichostrongylidae) and by *Chabertia ovina* (Strongylidae) following repeated experimental infections of sheep with these nematodes. JOHN S. ANDREWS.

On May 17, 1933, a parasite-free lamb, 53 days old, was fed a large number of infective larvae of *Nematodirus spp.* At intervals of 1, 14, 19, 28, 68, 71 and 100 days, respectively, following the first feeding, additional undetermined doses of infective larvae of *Nematodirus spp.* were given by mouth. The first positive fecal examination for eggs, determined by the salt flotation method, was found on the 20th day after the first feeding of the larvae. The egg count then gradually increased, reaching a peak of 160 eggs per gram of feces on the 54th day after the first dosing with larvae. On the 99th day after the first dosing with larvae the egg count dropped to 40 eggs per gram of feces and from the 113th to the 125th day, the count was between 3 and 4 eggs per gram of feces. There was a slight rise in egg production on the 144th day after the initial dosing, after which the number of eggs decreased, the animal remaining negative after the 265th day.

On June 6, 1933, a parasite-free lamb, 71 days old, was fed approximately 1000 infective larvae of *Chabertia ovina.* At intervals of 73, 79, and 96 days, respectively, after the first feeding of larvae, additional doses of approximately 1000 infective larvae were given. Eggs first appeared in the feces, as determined by the salt flotation method, on the 52nd day after the first feeding of larvae. The maximum egg count of 85 eggs per gram of feces was observed on the 79th day after the initial dosing with larvae. The number of eggs then decreased for a period of 23 days or until the 102nd day, after which the animal remained negative.

Observations on the development to egg-laying maturity of *Gongylonema pulchrum* (Nematoda: Spiruridae) in the guinea pig. J. E. ALICATA.

On July 15, 1933, a guinea pig was fed 10 encysted 3rd-stage larvae of *Gongylonema pulchrum,* recovered from the tissues of a cockroach, *Blattella germanica,* which had been infected experimentally with eggs from female specimens of *G. pulchrum* collected from cattle. On Feb. 12, 1934, about 7 months after experimental infection, the guinea pig died, having shown for 2 days prior to death paralysis of the hind legs; presumably the paralysis had no relation to the *Gongylonema* infection. One adult female *Gongylonema* was embedded in the epithelial layer of the esophagus (fig. 19A); no marked pathological change was noted in the esophagus as a result of this infestation.

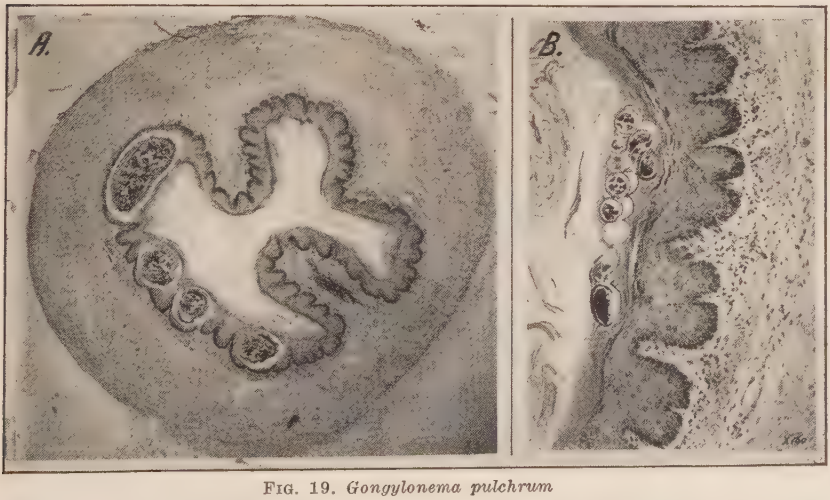

FIG. 19. *Gongylonema pulchrum*

A—Cross section of esophagus of guinea pig showing worm embedded in the epithelium; B—Portion of cross section of esophagus showing a group of eggs in the stratum corneum.

Eggs were found in batches in the stratum corneum of the epithelium (fig. 19B), and some eggs were seen in the lumen of the esophagus. It is possible that the eggs reached the lumen by being gradually pushed out by the surrounding tissue or as a result of desquamation of the epithelial layer in the region where the eggs were located.

The influence of a number of factors upon the activation of dormant or quiescent bulb nematodes, *Anguillulina dipsaco* (Kuhn, 1858) Gerv. & v. Ben., 1859 (Anguillulinidae). R. J. Hastings and W. Newton (Contribution No. 393 from the Division of Botany, Experimental Farms Branch, Department of Agriculture, Ottawa, Canada).

In studies of the destruction of bulb nematodes by hot water and other lethal agents many investigators have been at a loss to decide how long to maintain water suspensions of specific populations before assuming that lack of motility or quiescence is satisfactory evidence of death. Little information has been published as yet upon the factors that induce quiescence or dormancy or conversely the revival or activation factors. In our experiments on the effect of heat, the nematodes were heated in small sealed glass vials in a water bath, afterwards shaken out into 54-mm syracuse dishes containing 5 cc of tap water, maintained at room temperature and examined for motility 24 hours later. This technique has been criticised. Claims have been advanced that a 72-hour period at room temperature is required to induce maximum motility in a population inactivated by heat.

To evaluate the effect of hot water and other lethal agents upon the bulb nematode it is essential to distinguish death from a condition of quiescence, hence studies of the activation of quiescent nematodes are of practical value.

EXPERIMENTAL

The inoculum used throughout these experiments consisted of dry masses of dormant pre-adults removed from narcissus bulbs and stored in glass vials for a period of not longer than 6 months. Portions of these dry clusters were placed directly into uniform 14-mm diameter test tubes and 54-mm diameter syracuse dishes and maintained at room temperature, approximately 20 degrees C. The figures representing the percentage of motile nematodes in the following tables are only approximate, being based upon counts in a number of microscopic fields.

When similar volumes of dormant pre-adults suspended in tap water were placed in test tubes and syracuse dishes the revival rate was greater in syracuse dishes as shown in Table 1.

Table 1—The influence of duration of exposure and shape of container upon the revival of dormant pre-adult nematodes suspended in 5 cc of tap water.

Container	Hours in water					
	18	22	24	42	48	120
	Percent motile					
Test tube	30	40	50	0	30	5
Syracuse dish	80	80	90	90	90	90

In miscellaneous experiments it was noted that when bulbs in an advanced state of decay were crushed in tap water the nematodes often remained dormant over very long periods. The influence of an extract of rotten bulbs at various dilutions is reported in Table 2. The bulb extract was prepared by macerating in 200 cc of tap water three soft narcissus bulbs 35 mm in diameter. After 24 hours the supernatant liquid was decanted and dormant nematodes were added to this liquid and dilutions thereof. In contrast with water suspensions there was no significant revival in test tubes in the presence of the bulb infusion except when highly diluted. On the other hand when the bulb infusion suspensions were placed in syracuse dishes the bulb infusion inhibited the recovery of motility only to a slight degree and only when highly concentrated.

TABLE 2—The influence of time and the container shape upon the revival of dormant nematodes suspended in 5 cc of bulb infusion and dilutions thereof.

Solutions	Test tubes Hours in solution 24	48	120	Syracuse dishes Hours in solution 24	48	120
	Percent motile			Percent motile		
Bulb infusion	0	2	0	0	80	50
1/2 conc. infusion	0	0	0	60	80	50
1/4 conc. infusion	0	0	0	90	80	40
1/8 conc. infusion	0	0	0	90	90	30
1/16 conc. infusion	0	0	0	90	80	90
1/32 conc. infusion	0	0	0	90	90	90
1/64 conc. infusion	50	20	5	90	90	90
Tap water (check)	50	30	5	90	90	90

In view of the fact that the surface exposed to air appeared to influence the percentage motility in nematode populations when suspended in a bulb infusion, the influence of the solution depth was studied and the results are recorded in Table 3. It will be noted that percentage motility decreased with increase in depth proving that the surface exposed to air is an important factor in the induction of motility.

TABLE 3—The influence of solution depth upon the motility of pre-adult populations.

Hours in solution	Bulb infusion Depth in mm 1.25	2.5	5.0	10.0	Tap water Depth in mm 1.25	2.5	5.0	10.0
	Percent motile				Percent motile			
18	80	10	5	0	50	20	10	10
24	80	10	20	0	50	20	10	20
42	80	20	25	0	50	20	15	20
48	80	40	30	0	30	20	10	10
66	80	30	40	0	30	30	10	30
72	80	30	30	0.5	30	30	10	30
120	80	30	30	0.5	40	30	30	30

The results showing the influence of displacing the air over syracuse dishes with carbon dioxide are given in Table 4. It will be noted that none of the dormant nematodes became motile when surrounded by an atmosphere of carbon dioxide and that a 20-hour exposure to carbon dioxide appeared to exert a permanent effect for after replacing the carbon dioxide with air, only 20 percent had become motile within 96 hours.

TABLE 4—The influence of time and an atmosphere of carbon dioxide upon nematode revival in water, and the effect of replacing the carbon dioxide with air.

Hours in water	Atmosphere surrounding syracuse dishes Air	Carbon dioxide	Carbon dioxide 20 hrs. air balance of period
	Percent motile	Percent motile	Percent motile
20	80	0	..
23	80		5
26	80		10
44	80		10
116	80		20

Similar results were not obtained when the quiescent condition was induced by storing in test tubes in contact with bulb infusions. After storage for as long as 144 hours in test tubes, when these suspensions were transferred to syracuse lishes 50 percent or over became motile within 24 hours, as shown in Table 5.

Table 5—The activation of quiescent nematodes suspended in various concentrations of bulb infusion by transferring 5 cc quantities from test tubes to syracuse dishes.

Solutions	Hours in test tube	Hours in syracuse dish after transfer					
	144	3	6	24	30	48	72	120
	Percent motile	Percent motile						
Bulb infusion	0	0	2	50	60	60	60	20
1/2 conc. infusion	0	0	5	60	60	60	50	30
1/4 conc. infusion	0	2	10	80	80	70	50	30
1/8 conc. infusion	0	10	20	80	60	80	80	50
1/16 conc. infusion	0	50	60	60	60	80	80	70

SUMMARY

When dormant pre-adult nematodes are suspended in tap water a much smaller percentage become motile when equal volumes are placed in 14-mm diameter test tubes compared with 54-mm syracuse dishes. Further evidence that the amount of the surface of the suspension exposed to air is an important factor in the induction of motility was obtained by the discovery that the recovery of motility in populations progressively decreased with the depth of the solution in which the dormant pre-adults were suspended.

The suspension of pre-adults in an infusion of rotten bulb tissue markedly inhibited the recovery of motility but the inhibition was much less pronounced when the suspensions were maintained in shallow syracuse dishes.

When air was replaced with carbon dioxide gas over water suspensions in syracuse dishes, the recovery of motility was entirely prevented. The carbon dioxide appeared to injure the nematodes for after a 20-hour exposure a transfer to a normal atmosphere did not induce a normal recovery.

Little evidence was obtained that prolonged contact with an infusion of rotten bulbs has a similar effect.

Procephalobus mycophilus n. g., n. sp. (Cephalobidae), a nematode living in the sclerotia of the fungus _Balansia claviceps_. G. Steiner.

Cenchrus echinatus L. and various other grasses of Mexico, Florida and the West Indies are found infested, according to Diehl (1930, J. Agric. Research, 41: 761-766), by the fungus _Balansia claviceps_ Speg., which forms a sclerotium as a blackish body surrounding the aborted inflorescence, all more or less hidden within the leaf sheath. Within these sclerotia (kindly submitted by Dr. Diehl) large numbers of an undescribed nemic species, _Procephalobus mycophilus_ n. g., n. sp., have been found. It seems that this nema uses the sclerotia for food and is otherwise remarkably fit for a close life association with this fungus by its ability to pass through long periods of dryness in a dormant stage and revive if moisture is supplied. Such sclerotia from _Cenchrus echinatus_ were kept absolutely dry since March 1928, and showed revivals of the parasitizing nemas up to July 1933, but not after that time. Observations seem to indicate that the association of fungus and nematode also includes a carrier relationship since there is a possibility that the nema may distribute fungal spores.

Division of the former genus Cephalobus.—It has been found that _Cephalobus persegnis_ Bastian, 1865, type species of the genus _Cephalobus_, has 3 labial probolae. Therefore the genus _Acrobeloides_ Cobb, 1924, which was based upon the presence of 3 such labial probolae, becomes a synonym of _Cephalobus_, the latter name having priority. This necessitates one or more new generic names for the other species hitherto classed as _Cephalobus_. _Neocephalobus_ Steiner, 1929, was formerly proposed as a sub-generic name for forms with a buccal cavity in which the cuticularized plates of the posterior portion had disappeared, leaving only a dorsal and ventral toothlet, and with a male having ventromedial preanal papilla not seen in other cephalobi. This subgenus is now raised to generic rank.

Genus _Neocephalobus_ Steiner, 1929

Diagnosis (emended).—Cephalobinae: Probolae or cephalic processes absent, with 6 equal or unequal lips; buccal cavity cephaloboid, of conical, tubular shape, with part of the buccal armature reduced to membranous walls or replaced by toothlets. Prodelphic.

Procephalobus, n. g.

Diagnosis.—Cephalobinae: Probolae or cephalic processes absent, but with 6 lips and a full set of armature plates in the conical, tubular buccal cavity, and with prodelphic female apparatus.

Type species.—*P. mycophilus*, n. sp.

Procephalobus mycophilus, n. sp.

Description.—Closely related to *Rhabditis* by its head structures. Female and male both of medium size but differing in the shape of the tail, which in the female is long and conical, tapering more or less regularly to a fine point, and in the male is shorter, with a pointed terminus set off from a short conical base. Cuticle distinctly annulated (about 6 annules to 5μ in the anterior region of the esophagus). Lateral membranes edge a lateral field of about 8μ width. Head not set off, with 6 equal, pointed and distinct lips. Submedial lips apparently with 3 papillae, 1 anterior, 2 posterior; of these posterior papillae the median ones are the more strongly developed; lateral lips with an anterior and single posterior papilla. Amphids small, slightly dorsal, posterior to lateral papillae. Buccal cavity typically cephaloboid, strictly conical, with full set of armature plates (cheilo-, pro-, meso-, meta- and telorhabdions) but without denticulation. Esophagus typical, corpus slightly set off from middle bulb, which is about 3 times as long as wide; isthmus slender; terminal bulb subspherical with complete and well developed set of valves. Esophageal lumen anteriorly triradiate, the ventral radius having no circular dilation (fig. 20C). Outlet of dorsal esophageal gland apparently at beginning of esophagus, that of ventrosubmedial gland in posterior part of middle bulb. Intestinal cells large, flat, apparently 2 in a transverse section. Rectum 1½ times as long as anal body-diameter; 3 rectal glands present. Excretory pore and cervical papillae (deirids) at latitude of nerve ring. Phasmids distinct in both sexes. Female sexual apparatus as in other cephalobs, ovary without double flexure. Testis not reflexed; spicula arcuate, widening proximally, not cephalated; gubernaculum ½ spicula length, slightly curved, pointed at both ends, gradually increasing in width toward the middle. Arrangement of papillae: Ventrosubmedially, 1 at latitude of end of intestine, 1 at latitude of anus and 1 in the middle of conical basal portion of tail; dorsosubmedially and dorsosublaterally, 1 behind anus, 1 at about the beginning of last third of conical basal portion of tail, and 1 at base of terminal point of tail just behind the phasmid. For copulatory muscles as far as located, see figure 20D.

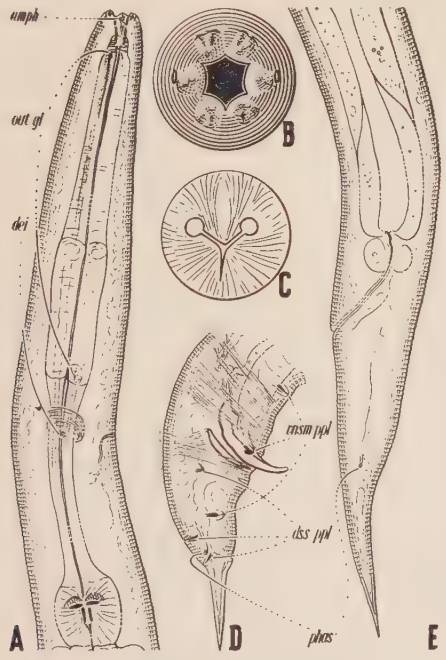

FIG. 20. *Procephalobus mycophilus*, n. g., n. sp. A—Esophageal region: *amph.* amphid; *out gl.* outlets of esophageal glands; *dei.* deirid. B—Top view of head, showing position of labial papillae and amphids. C—Cross section at beginning of esophagus. D—Tail of male: *vnsm ppl*, ventrosubmedial papillae; *dss ppl*, dorsosubmedial and dorso-sublateral papillae; *phas*, phasmid. E—Tail of female: *phas*, phasmid. A. D and E, X 670; B and C, x 1850.

Measurements.—♀: Total length=0.67-0.87 mm; a=21.8-23.1; β=4.6-5.2; γ=12; vulva=57-59 per cent. ♂: Total length = 0.62-0.73 mm; a=24-24.4; β=4.3-4.6; γ=12.5-13.

Diagnosis.—*Neocephalobus* with elongated, conically tapering tail in the female; basal portion of tail set off, short, conical, with mucronate terminus in the male. Six equal lips, the lateral with 2, the submedial with 3 small setose papillae. Buccal cavity typical, with full set of armature plates, without denticles. Middle esophageal bulb about 3 times as long as wide, terminal bulb subspherical

with full set of valves. Female apparatus typical but ovary without double flexure. Spicula arcuate, not cephalated, but broad proximally, tapering distally; gubernaculum 1/2 spicula length, slightly arcuate, sublineate, with double contour. Six pairs of copulatory papillae: Ventrosubmedially, 1 each in about latitude of end of intestine, in latitude of anus, and at middle of conical, basal portion of tail; dorsosublaterally and dorsosubmedially, 1 behind anus, 1 at about beginning of last third of conical tail portion and 1 at base of mucronate terminus.

Type host.—Sclerotia of *Balansia claviceps,* a fungus parasitizing *Cenchrus echinatus.*

Type locality.—United States (Florida).

Some remarks about the nematodes *Cephalobus contractus* (Cephalobidae) and *Diplogaster aerivora* (Diplogasteridae). G. Steiner.

In a diseased celeriac root (*Celeri graveolens rapaceum* DC) from Sweden, found in ship's stores intercepted by inspectors of the U. S. Bureau of Plant Quarantine at Baltimore, Maryland, in February, 1934, the following nemas were observed: *Aphelenchoides parietinus* (Bastian, 1865) Steiner, 1932, *Aphelenchus avenae* Bastian, 1865, *Cephalobus contractus* (Thorne, 1925) emend., and *Diplogaster aerivora* Cobb, 1916. It is the first time that the last 2 species have been recorded from Europe.

Cephalobus contractus shows marked variation in the shape of its probolae. In the type as described by Thorne the probolae are bifurcate 1/3 to 1/2 their length and apparently symmetrical. The present material included several specimens, none of which was similar to the type in this respect. A single specimen exhibited slightly bifurcate probolae (fig. 21G) whereas the others were more or less as shown in figure 21H. A specimen of apparently the same species was previously observed in the bud of a strawberry plant from Riverhead, N. Y. In this specimen the asymmetry within each probola (fig. 21 I) was even more pronounced than in the Swedish material. In other characters, however, these various specimens agree with the type fairly well. Attention is called to the fact that the buccal armature is not very strongly developed except the cheilorhabdions which are short and thick, whereas the pro-, meso-, meta- and telorhabdions are thin but otherwise well differentiated. Esophagus very slender with middle bulb not set off. Rectum 1 1/3 times the anal body diameter. Phasmid in middle of tail. Vulva not always prominent; female apparatus to left of intestine, ovary with double flexure close behind vulva, ending slightly posterior to midpoint between vulva and anus; uterus with short postvulvar branch. Measurements.—Specimen from Sweden: Total length, 0.59 mm, a=23, β=3.7, γ=19.3, v=66.8 percent. Specimen from New York State: Total length, 0.548 mm, a=20.3, β=4.3, γ=16, v=66 percent.

Diplogaster aerivora is doubtless a widely distributed and common form, although there have been no other records of its occurrence outside the United States. The specimens from Sweden agreed morphologically with those recorded from the United States except that in the male both the ventrosubmedial and the sublateral copulatory papillae opposite the anus are in almost the same latitude, whereas in specimens from the United States the ventrosubmedial papilla is a short distance farther forward. Cobb's description of this species is very accurate and complete. Since, however, no satisfactory figures have been published, those given here (fig. 21 A-F) may help in recognizing the species. The serial punctation of the cuticle, usually very obscure, may be made visible through intra-vitam staining with methyl blue. The series bordering what may be called the lateral area are slightly larger and more confluent (fig. 21E); the area between them is not so wide as between the other series. The total number of series is estimated at 32. Lateral wings were not seen. As far as could be ascertained there is a single papilla on the lateral lip and 2 on the submedial lips as described by Cobb. The posterior submedial papilla, however, does not protrude over the surface (fig. 21B) and has a position nearer the medial line than has the anterior papilla. Apparently, therefore, of the supposed 2 original posterior submedial papillae in the ancestors of the present form, only the medial one persists, and that in a reduced stage.

In figure 21A an attempt is made to homologize the various elements of the buccal cavity in the present *Diplogaster* with those of the rhabditids and cephalobs. The dorsal tooth may be homologus to the one on the dorsal metarhabdion

in some of the cephalobs. It may be that the ventrosubmedial tooth also belongs to this same region. A rather close relationship between the cephalobs and the diplogasters is suggested.

Among the diplogasters the position of the esophageal glands and their outlets has been hitherto unknown. In the present species the dorsal as well as the ventrosubmedial glands empty as they do in the cephalobs, rhabditids and related

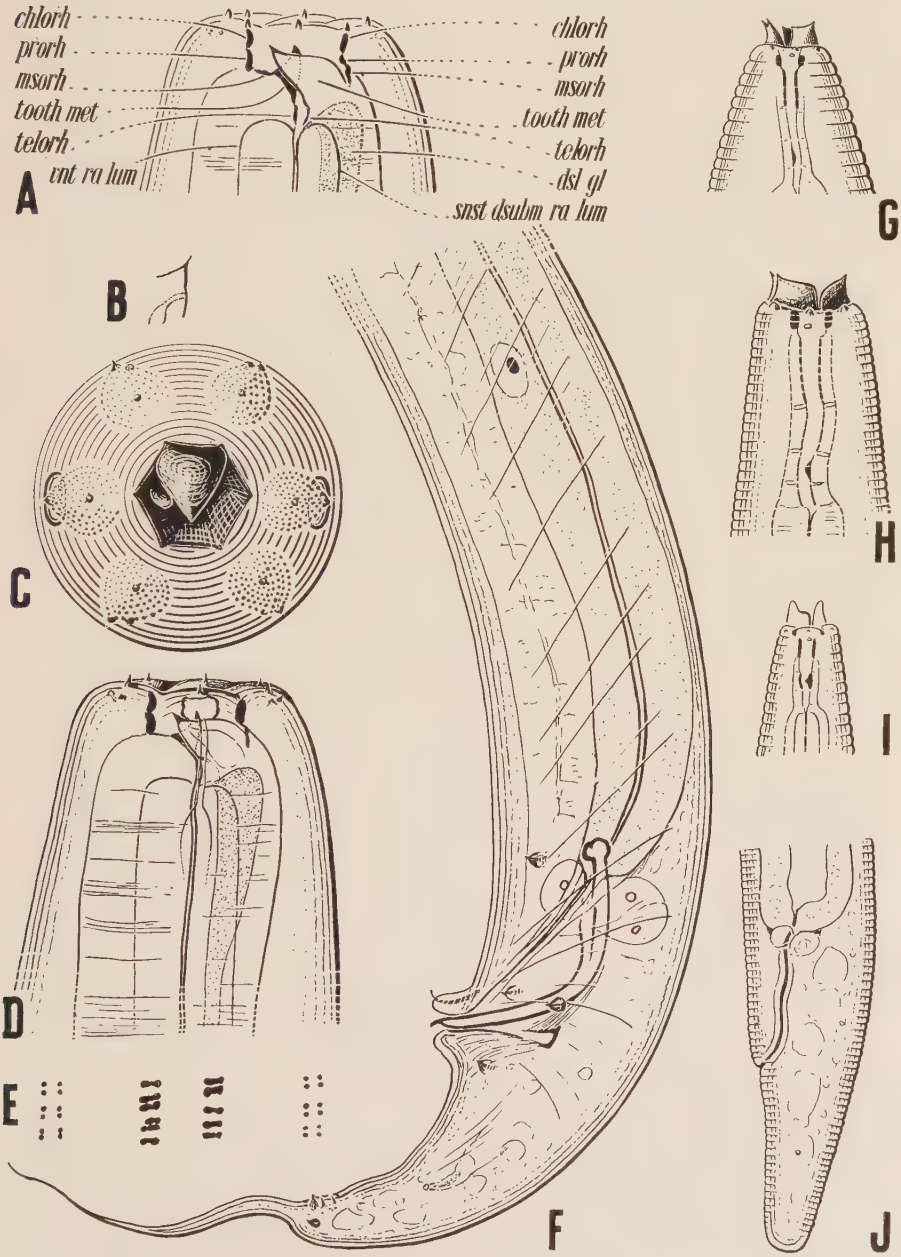

FIG. 21

A-F—*Diplogaster aerivora.* A—Schematic drawing of head: *chlorh,* cheilorhabdion; *prorh,* prorhabdion; *msorh,* mesorhabdion; *tooth met,* tooth on metarhabdion; *telorh,* telorhabdion; *vnt ra lum,* ventral ray of esophageal lumen; *dsl gl,* outlet of dorsal esophageal gland; *snst dsubm ra lum,* left dorsosubmedial ray of esophageal lumen. B—Posterior submedial papilla not protruding over surface of lip. C—Front view of head. X 2800. D—Head. X 2100. E—Serial punctation of cuticle with confluence of series bordering lateral area. X 2100. F—Posterior portion of male. X 1030. G-J—*Cephalobus contractus.* G—Head, showing bifurcate probola. X 1400. H—Head, showing asymmetry of probola. X 2100. I—Specimen from strawberry bud showing more pronounced asymmetry of probola. X 1030. J—Tail of female. X 800.

groups, that is, the dorsal at the beginning of the esophagus, the two others in the posterior portion of the middle bulb. The nuclei of the gland cells likewise appear to be in the terminal bulb.

Gooseberry plants and lilies attacked by the strawberry nematode, *Aphelenchoides fragariae* (Anguillulinidae). G. Steiner.

Finding nematodes of the *Aphelenchoides fragariae* type in new hosts is of interest from both the plant pathological and the taxonomic point of view. Some authors are still inclined to consider *Aphelenchoides fragariae* (Ritzema Bos, 1891), *A. olesistus* (Ritzema Bos, 1893), *A. ritzemabosi* (Schwartz, 1911), *A. subtenuis* (Cobb, 1926) and *A. ribes* (Taylor, 1917) as different species, whereas Steiner and Buhrer previously synonymized all except the last mentioned. Having at that time no material of *A. ribes* for study, these writers regarded a statement as to its taxonomic status as premature. Recently, however, gooseberry leaves and buds (*Grossularia reclinata*) from Albion, Calif., were received through C. E. Scott and H. N. Hansen of the California Agricultural Experiment Station. *A. ribes* has been known only from the black currant (observed three times in England). On finding the infestation of the gooseberry plant, the possibility of its being caused by *A. ribes* was at once considered. A careful comparison of the specimens with the original description of this species by A. M. Taylor and the later redescription by T. Goodey failed to furnish any differentiating characters. The present gooseberry plant infestation is undoubtedly caused by an *Aphelenchoides* species morphologically identical with what was described as *A. ribes* but it is also identical with *A. fragariae*. *A. ribes* is, therefore, considered synonymous with *A. fragariae*.

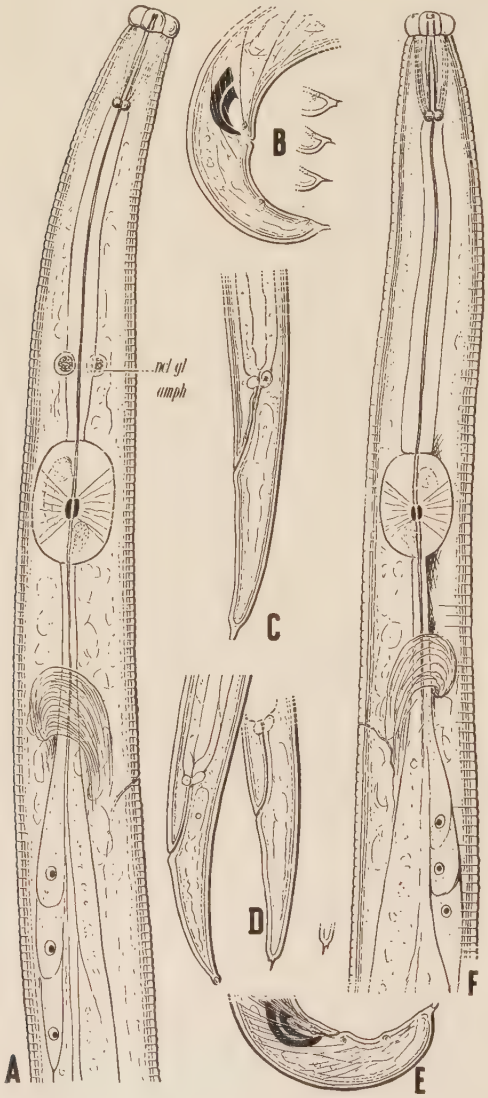

Fig. 22. *Aphelenchoides fragariae*

A—Anterior portion of specimen from the lily; *ncl gl amph*, nucleus of amphidial gland. B—Tails of male specimens from the lily, showing variation in shape of mucro. C—Tail of female specimen from the lily. D—Tails of 3 females from the gooseberry, showing variation in shape of mucro, that on the left being the most common. E—Tail of male specimen from the gooseberry. F—Anterior portion of specimen from the gooseberry. A and F are X 1000; all others are X 530.

Descriptive remarks concerning the form from the gooseberry plant.—Size and shape of the body agree very well with the typical strawberry nematode, as may be seen by comparing the following formulae: ♀: Total length = 0.9-1.0 mm; a = 46.3-56.2; β = 8.9-12.5; γ = 25.4-29.2; vulva at 68-71 percent; ♂: Total length = 0.817-0.933 mm; a = 44.7-48.2; β = 11.9-13.1; γ = 21.6-31.

The cuticle exhibits an extremely fine annulation, difficult to observe, each annule being about 1μ wide. There are 2 minute lateral membranes bordering a lateral field about 1/5 as wide as the body. The tail is comparatively short but otherwise its form presents no differentiating character; in most of the females the terminal point had the shape shown in figure 22 D (at left); others that of figure 22 D (middle and right). According to our observations, position, size and shape of this mucro vary greatly in specimens of *A. fragariae*, although populations from the same locality are usually uniform in this regard. In the present form the head is about 2.6μ long and 6μ wide, well set off. From in front it exhibits the 6-rayed frame-work typical of the species. There is a papilla in each submedial, and an amphidial opening in each lateral sector. According to our measurements, the length of the buccal stylet varies between 10 and 13.5μ; its base has well developed knobs. The esophageal glands empty into the bulb as is typical in the genus; the glands are arranged tandem on the dorsal side of the anterior portion of the intestine. The cells of the intestine are about 80μ long and arranged in alternating pairs, each pair forming the entire circumference of the intestine. The usual rectal glands are present, but quite small. The excretory pore opens ventrally a short distance behind the nerve ring. The female sexual apparatus has a posterior uterine branch extending about 3/5 the distance from vulva to anus. The ovary is outstretched anteriorly and has a left, ventrosubmedial position; the oviduct is an outstanding feature of the female sexual apparatus. The uterus as well as its postvulvar branch serves as receptaculum seminis. The male tail is rather short, but otherwise resembles the type with its triple groups of papillae (fig. 22 E).

The infested gooseberry leaves were received dry and the nemas proved to be dormant, adults and larvae reviving in about an hour after soaking.

Remarks on specimens from the lily bud.—The diseased lily (*Lilium philippinense formosanum grandiflora*) originated in Japan and was imported under the varietal name Takasago. It was grown at Moss Beach, Calif., and also submitted by C. E. Scott and H. N. Hansen.

The nematode involved in this disease rather closely resembles typical *Aphelenchoides fragariae*. It is therefore thought best to mention but a few points of special interest wherein it differs from the type. The measurements are as follows: ♀: Total length = 0.53-1.037 mm; a = 36-47.4; β = 8.4-13.2; γ = 15.6-23.7; v = 68-73 percent. ♂: Total length = 0.60-0.79 mm; a = 31-36.6; β = 7.7-10.4; γ = 16.3-21.6. A larval specimen (before last molt) 0.658 mm in total length had a = 34; β = 9; γ = 11.7. Uterine eggs were not seen; an egg in the oviduct measured 77μ by 17μ. It may be seen that the present specimens, especially the males, are thicker than the type. In this regard they approach *Aphelenchoides parietinus* (Bastian, 1865). The tail is relatively longer than in the gooseberry form; in the female its terminal point is of regular shape and much like that of typical *A. fragariae;* in the male, however, the terminal point varies and is irregular in shape (fig. 22 B). In most of the specimens the male copulatory papillae had their usual position but in some the papilla, usually opposite the anus, was shifted forward to a somewhat preanal position as shown in figure 22 B (left). A most interesting observation was made in one specimen. What was thought to be the nucleus of the amphidial gland was seen slightly ventrosublateral and in front of the esophageal bulb (fig. 22 A). There is, of course, one nucleus on each side; they are relatively large.

The lily material was received dry and the nemas were dormant; upon soaking for over an hour, preadult larval specimens revived.

***Aphelenchoides fragariae* (Nematoda: Anguillulinidae) infesting begonias in the Pacific Northwest.** WILBUR D. COURTNEY and HENRY J. REYNOLDS.

The causative agent of a nemic disease of fibrous rooted begonias grown in greenhouses in the Puget Sound region of Washington state has been identified as *Aphelenchoides fragariae* (Ritzema Bos, 1891) Christie, 1932. Some of the more important commercial varieties of begonias have not been grown here extensively in recent years because of this disease which was observed first in 1929 on be-

gonia plants imported from northwestern Oregon where it had been known since 1920. Since its entry into Washington the disease has spread over at least the coastal region.

Microscopic examination of even apparently healthy leaves (fig. 24 A) showed considerable numbers of *A. fragariae*. The macroscopic indication of disease noticed first was the appearance of slightly rusty brown spots between the leaf veins, visible from the under surface of the leaf when held against a strong light. The spots next appeared to coalesce and turn a darker brown in color, the tissue around the margin of the leaf dying and becoming dry and brittle (fig. 24 B). The lesion then seemed to expand toward the leaf center, spreading between the larger veins, until the entire leaf was killed (fig. 24 C and D). The end of the petiole and the larger veins were the last to die.

Fig. 23

Begonia plant almost defoliated by attack of *Aphelenchoides fragariae*.

There was 1 case noted, however, where symptoms differed considerably in that the rusty brown area was limited to the junction of the petiole and leaf. This area seemed to be the only place where there was a heavy concentration of nemas. The discolored portion did not increase in size but within 2 days the remainder of the leaf had wilted and soon died. It appeared as if the vascular bundles had been interfered with, leaving the leaf destitute of liquids and consequently of turgidity.

As the parasites occur within the tissues of the plant it can readily be understood that cuttings from infested stock would later show heavy infestation.

Growers may control the disease by (1) using clean begonia stock for cuttings; (2) planting in properly sterilized soil and growing on sterilized benches; (3) watering plants individually without wetting foliage; (4) keeping the plants separated on the benches (see also Gill, 1933, Florist Exch., 81 (44):11; 1934, Phytopath., 24:9).

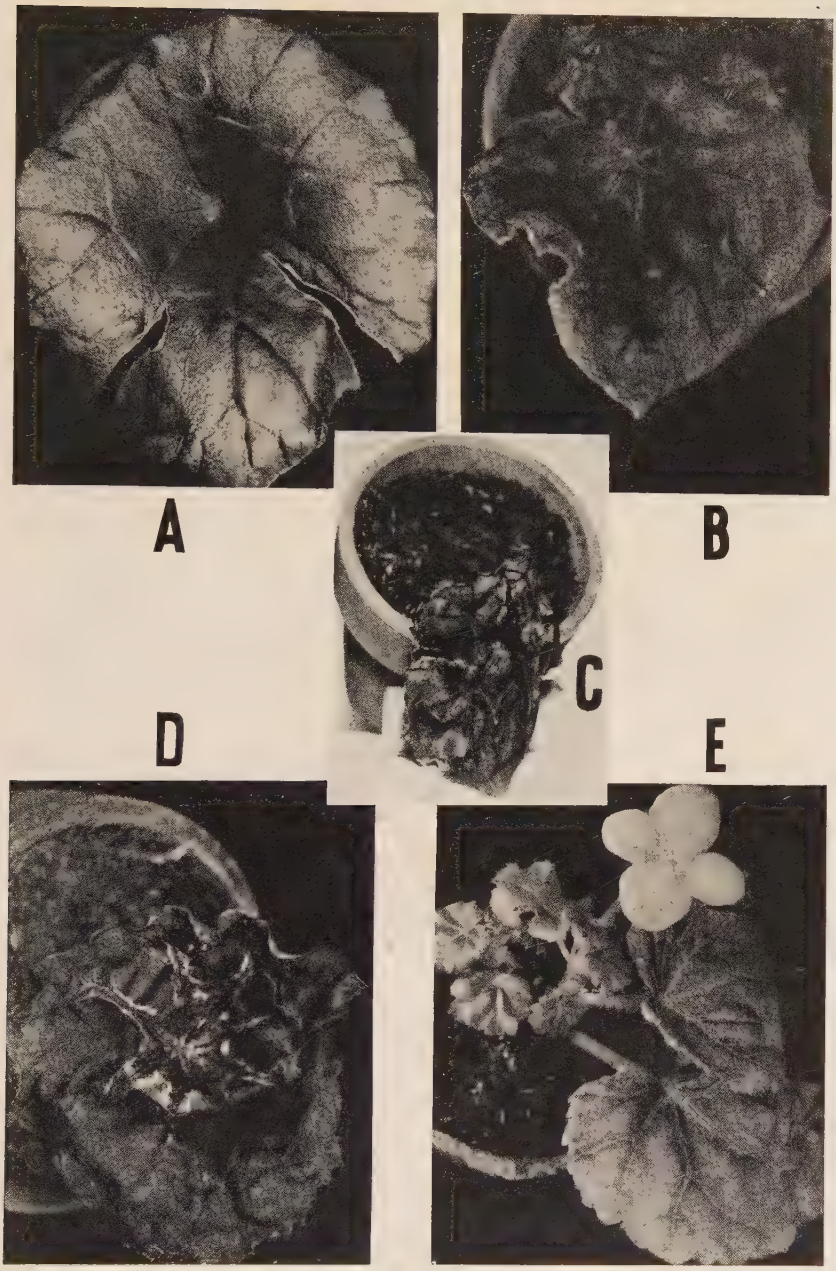

FIG. 24

Infestation of begonia with *Aphelenchoides fragariae*. A—Leaf, apparently normal, but many nemas taken from cut areas. B—Leaf showing first discoloration of the margin. C—Leaf, dead. D—Leaf, margin, dead. E—Plant stunted from nema attacks; normal plant of same age should be 5 times this size.

Cysticercoids of the crow cestode, *Hymenolepis variabilis* (Mayhew, 1925) Fuhrmann, 1932 (Hymenolepididae). Myrna F. Jones.

Eggs and gravid segments of *Hymenolepis variabilis,* collected from a crow in March, 1930, were fed to dung beetles (*Aphodius granarius*) and subsequently cysticercoids identified as those of *H. variabilis* were found in 4 of the beetles. In June, 1933, similar material was fed to a miscellaneous collection of coleopterans and to laboratory-reared grasshoppers. Cysticercoids were obtained from 1 specimen of *A. granarius,* from 1 staphylinid (*Oxytelus* sp.) and from 4 grasshopper nymphs (*Melanoplus ? bivittatus*). Only 1 cysticercoid was obtained from the staphylinid; from 2 to 20 invaginated and apparently completely formed cysticercoids were collected from the grasshoppers; as many as 30 immature larvae and 8 apparently fully developed cysticercoids, were obtained from specimens of *A. granarius.* The staphylinid was examined 11 days after being fed tapeworm eggs, the grasshoppers after 12 days (1 specimen) and 14 days (3 specimens), and the dung beetles after 7, 8, 14, 15, and 17 days, respectively. The time necessary for development of the cysticercoid apparently varies with the season and the temperature; possibly 11 to 14 days are sufficient in midsummer. However, as feeding experiments with 2 chicks and 1 pigeon were negative, it was not demonstrated that the larvae obtained were actually infective.

Eggs of *H. variabilis* are 70 to 80μ by 55 to 65μ; oncospheres are 28 to 30μ by 25 to 28μ; embryonal hooks are about 18μ long. The youngest larvae observed, collected from a specimen of *A. granarius* which died 7 days after being fed eggs of *H. variabilis,* were spherical or ellipsoidal in shape, and 120 to 130μ in maximum diameter. Older larvae (fig. 25 C) from *A. granarius,* fed eggs of *H. variabilis* 8 days previously, were 500 to 750μ long, with 1 constriction. The body region is composed of dense tissue at the anterior (cephalic) extremity and loose tissue in the inner region, the developing primitive cavity; the caudal region contained 6 embryonal hooks 18μ long.

Later stages of development show further elongation of the larva and differentiation of suckers, rostellum and rostellar hooks. Calcareous corpuscles become prominent posterior to the suckers. It appears that in most details structural differentiation of the scolex occurs before invagination but that final differentiation, especially of the rostellum and rostellar sac, is not completed until after the scolex is invaginated. No larva in the process of invagination was observed.

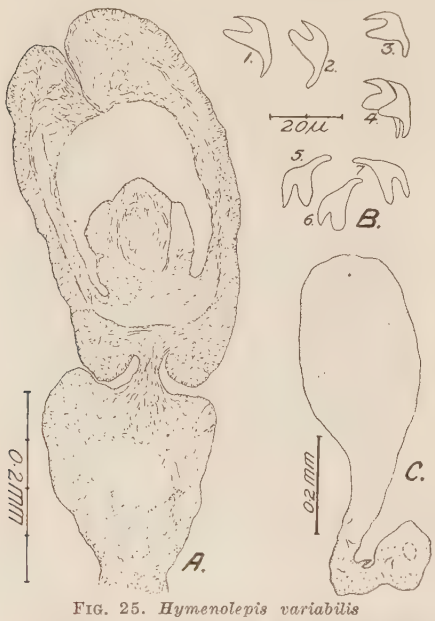

Fig. 25. *Hymenolepis variabilis*
A—Section of cysticercoid from *Melanoplus ?bivittatus;* B—Rostellar hooks from cysticercoids (1, f om *Oxytelus* sp.: 2-4, from *Aphodius granarius;* 5-7, from *M. ?bivittatus*); C—Elongate larva from *A. granarius* 8 days after feeding.

Cysticercoids (fig. 25 A), apparently completely formed, are ellipsoidal in shape, varying in size from 225 to 210μ by 200μ, from *A. granarius,* to about 385μ by 280μ, from *M. ?bivitattus.* The one cysticercoid from *Oxytelus* sp., as a flattened slide mount, measured 350μ by 280μ. The caudal appendage, easily broken and lost, is comparatively large, measuring as much as 250μ wide by 2 mm long in specimens from grasshoppers.

The cysticercoid proper consists of a cyst wall composed of cuticula, basal membrane, parenchymatous and fibrous tissue inclosing remnants of the early primitive cavity, and of a thin inner cuticula which is continuous with the cuticula covering the scolex. The scolex, inclosed in a comparatively large invagination cavity, varies from 88μ wide (lateral view of 1 specimen from *M. ?bivittatus*) and 110 to 126μ wide (specimens from

A. granarius) to 140μ wide (flattened specimen from *Oxytelus* sp.); suckers 52 to 80μ in diameter; rostellum, in moderate state of contraction, 150μ long by 35μ wide; 10 rostellar hooks (figs. 25B, 1-7) 18 to 22μ long.

The complete life cycle was not demonstrated experimentally since feeding experiments with 2 chicks and pigeon gave negative results; therefore, it can only be stated that *Aphodius granarius, Oxytelus* sp., and *Melanoplus ?bivittatus* are potential intermediate hosts for *Hymenolepis variabilis.*

New bird hosts for the acanthocephalid *Plagiorhynchus formosus* (Echinorhynchidae). EUGENIA CUVILLIER.

Several specimens of an acanthocephalid collected from a catbird, *Dumetella carolinensis,* at New Brunswick, N. J., by F. R. Beaudette, and from a thrush, *Hylocichla* sp., at Washington, D. C., by E. E. Wehr, have been identified by the writer as *Plagiorhynchus formosus.* So far as is known, these findings constitute new host records for this parasite. The number of hooks on the proboscis of these worms was found to be less than that previously described for this species. Whereas Van Cleave reports 13 to 14 hooks in each of the 16 longitudinal rows, the present specimens show only 11 to 12 hooks per row. However, since the worms correspond in all other respects to the description of *P. formosus* as given by Van Cleave, it appeared that the number of proboscis hooks per row in this species may vary from 11 to 14.

In the opinion of the writer, this parasite is of potential economic importance. Although, to date, it has been reported only once from a chicken, the common pillbug, *Armadillidium vulgare,* reported by Sinitsin (1929, J. Parasitol., 15: 287) as its intermediate host, is often eaten by chickens. In view of the fact that 5 species of wild birds, including those mentioned above, are known to harbor this parasite, an increase in its incidence in our domesticated birds may well be expected.

New records of helminth parasites. G. DIKMANS.

(1) *Nematodes from a deer.*—Nematodes collected from a deer, *Odocoileus virginianus,* in New York State and recently submitted to the U. S. Bureau of Animal Industry were identified as *Ostertagia circumcincta, O. odocoilei, O. mossi, Chabertia ovina* and *Cooperia* sp. *Ostertagia odocoilei* has been reported from deer in Pennsylvania and Louisiana and *O. mossi* from deer in Pennsylvania. *Chabertia ovina* has been reported from the black-tailed deer, *Odocoileus columbianus* but not from *O. virginianus.* As far as the writer is aware no species of *Cooperia* has been reported from deer in the United States. Owing to the absence of males a specific determination of the *Cooperia* mentioned above was not attempted.

(2) *Skrjabinema ovis from a goat in Massachusetts.*—A few specimens of this nematode, collected from a goat in Massachusetts, were recently received from Col. R. A. Kelser, Veterinary Corps, United States Army. This nematode has previously been reported from goats in Nebraska and Maryland.

(3) *Macdonaldius sp., a new nematode from sheep in New Mexico.*—Dr. F. L. Schneider, Field Inspection Division, U. S. Bureau of Animal Industry, stationed at Albuquerque, New Mexico, recently forwarded to the Zoological Division some nematodes from a sheep, which were reported as having been collected from the carotid artery in the region of the parotid gland, and from the mesenteric and ileac arteries. The nematodes grossly resemble *Setaria labiato-papillosa* but Dr. B. G. Chitwood, to whom the specimens were submitted for examination, provisionally placed them in the genus *Macdonaldius.*

(4) *Haemonchus similis and Cooperia pectinata from Florida cattle.*—These nematodes, previously reported from cattle in Louisiana and Texas, were found among nematodes collected from the abomasum of a cow in Florida. The specimens were collected by Mr. J. Bozicevich.

(5) *New hosts for Moniezia benedeni.*—Tapeworms collected by Dr. R. R. Parker at Hamilton, Montana, from the mountain sheep, *Ovis canadensis,* and the buffalo, *Bison bison,* have been identified as *Moniezia benedeni.*

Nasal granuloma in cattle. G. Dikmans.

In 1930 the attention of the U. S. Bureau of Animal Industry was called to a disease of cattle in the Bureau of Dairy Industry herd at the Iberia Livestock Experiment Farm, Jeanerette, La. This disease was manifested clinically by an obstruction to respiration and histologically by the formation of granulomatous tissue in the anterior part of the nasal cavities. Specimens from the diseased animals were examined in the Pathological Division of the Bureau of Animal Industry during 1930-1932. The cause of the disease was not determined, but certain peculiarities of the lesions suggested that the condition might be due to an animal parasite and the problem was, therefore, referred to the Zoological Division. All attempts to find an animal parasite which might be the cause of this disease have failed. There have been found, however, both in the nasal secretions and in the nasal mucosa of affected animals, certain bodies which appear to have an etiological relation to the disease. These bodies bear some resemblance to the bodies figured as occurring in rhinosporidiosis.

The suborders and superfamilies of Acarina. Henry E. Ewing.

The early workers in the Acarina usually used suborders as first categories in their classifications of the mites. Later Banks introduced superfamilies, which he used to supplant the suborders. The present writer has employed superfamilies in his classifications but to supplement rather than supplant the suborders. This method allows for a better expression of the rank of the groups employed and a better indication of their relationships. In my manual of external parasites, published in 1929, a classification of the higher groups of mites containing parasitic species was given. That classification is here revised and extended to include all forms, whether free or parasitic. Some of the changes in this arrangement of the higher groups of mites are as follows:

1. The Notostigmata are given as a suborder of the Acarina. In these rare arachnids there are four pairs of stigmata which are situated dorsally on the abdomen.

2. The Pentastomida are included with the mites in the Acarina. Sambon, who recently published a synopsis of the group, considers them as constituting a family, the Linguatulidae, of the Acarina. Although their affinities with the mites are quiet evident, their exact position in the order can not be well determined.

3. The peculiar mite-like ticks, or should I say tick-like mites, of the family Spelaeorhynchidae are here raised to the rank of a superfamily. This is done chiefly because authorities can not agree whether to consider them ticks or mites.

4. Trägardh's new suborder, Palaeacariformes, established for some very primitive mites related on the one hand to the Cryptostigmata and on the other to the Devonian genus *Protacarus* is included, being assigned a place in front of the Cryptostigmata.

5. The indications are very convincing that the hair-follicle mites, Brachypoda, and the gall mites, Tetrapoda, both arose from forms which if living today would be placed in the suborder Prostigmata. For this reason these 2 degenerate groups are given a place immediately following the Prostigmata.

An Arrangement of the Suborders and Superfamilies of Acarina

I. Notostigmata
  1. Opilioacaroidea
II. Tetrastigamata
  1. Holothyreoidea
III. Mesostigmata
  1. Parasitoidea
  2. Spelaeorhynchoidea
  3. Ixodoidea

IV. Pentastomida
    1. Linguatuloidea
V. Stomatostigmata
    1. Labidostommatoidea
VI. Prostigmata
    1. Eupodoidea
    2. Caeculoidea
    3. Trombidioidea
    4. Hydrachnoidea
VII. Brachypoda
    1. Demodicoidea
VIII. Tetrapoda
    1. Eriophyoidea
IX. Palaeacariformes
    1. Palaeacaroidea
X. Cryptostigmata
    1. Oribatoidea
    2. Nothroidea
    3. Hypochthonioidea
    4. Hoplodermatoidea
XI. Heterostigmata
    1. Tarsonemoidea
XII. Astigmata
    1. Tyroglyphoidea
    2. Sarcoptoidea

The identity and proper scientific name for the sucking louse of North American domesticated pigs. Henry E. Ewing.

No less than nine distinct scientific names have been applied to lice of domesticated pigs or to those of wild pigs of the genus *Sus*, which genus includes the wild ancestor (or ancestors) of our domesticated pigs. The chief reason for there being so many names is that the lice from these different species of pigs, or from the same species in different parts of the world, differ in easily measurable taxonomic characters.

It has been shown recently that the outstanding differences between these hog lice are to be found between the lice of European wild boars, and the lice of both domestic and wild pigs of eastern Asia. Those forms of *Haematopinus* from European wild boars are more slender, have a much more slender head and a differently shaped one. The sternum of the European forms is about as long as wide, while the sternum of the Asiatic lice is only about ½ as long as wide. Also the paratergal plates, or lateral tergites, are only about half as long in the lice from European wild hosts as in lice from Asiatic hosts.

But what specific names shall we apply to these two species and what varietal name shall be applied to the louse of North American domestic pigs? For the European hog louse, 4 names come into consideration, but only 2 need be mentioned here. *H. suis* (Linnaeus) was described from *Sus scrofa*, under which name Linnaeus included both the wild boar of Europe and the domesticated pig. The first one really to revise the lice of *Sus* species was Fahrenholz, who limited *H. suis suis* to the wild boar of Europe, which is now known as *Sus scrofa*. Some doubt, however, exists as to the validity of such a limitation by Fahrenholz since Linnaeus indicated in a cross reference that his louse came from domesticated pigs.

If we can not accept the wild boar as the host of *H. suis suis*, it will lead to much confusion, since there are today in Europe at least 2 species of *Haematopinus* on domesticated pigs and 2 varieties of one of these species, hence there is no way of knowing what form Linnaeus had in Sweden almost 2 centuries ago. The probabilities are, however, that the *H. suis* of Linnaeus was similar to types found today on certain domesticated pigs in central Europe, which are in fact very similar to the louse on the wild boars, and which must be referred to the same species though probably not to the same variety. Hence there is no justification for using Linnaeus' name for the Asiatic hog louse.

The name *Haematopinus irritans* was proposed by Law in 1903 for *H. suis* for no evident reason. It is invalid under the law of priority.

If *Haematopinus suis* (Linnaeus) is left out of consideration in connection with the proper specific name for the Asiatic hog louse, which appears as the only constructive course to take, the following names are to be considered in its connection:

H. penicillatus Piaget (1885).—This louse, taken from a zebu in a zoological garden, can not be considered as a form of *suis* as has been suggested, since Piaget's drawing and description indicate clearly that he was dealing with a variety of *tuberculatus*, members of which occur on hosts of the family Bovidae.

H. suis adventicius Neumann (1911).—The type host of this species was designated by Fahrenholz as *Sus vittatus*. This is the wild hog of Sumatra. The louse has the specific characters—short, broad sternal plate and large paratergal plates—of the lice found on many domesticated Asiatic pigs. Although differing varietally from other forms taken from Asiatic and certain domesticated pigs, its name is the oldest available one for the Asiatic complex, hence the specific name for the Asiatic hog louse should be *Haematopinus adventicius* Neumann. Of this species there are 3 varieties.

H. suis chinensis Fahrenholz (1916).—This form should be regarded as *H. adventicius chinensis* Fahrenholz.

H. suis germanicus Fahrenholz (1916), should be regarded as *H. adventicius germanicus* Fahrenholz.

The first valid name, therefore, to be applied to lice of the Asiatic type occurring on domesticated pigs is *H. adventicius chinensis* Fahrenholz.

I have examined 10 lots of *Haematopinus* taken in North America, all probably coming from domestic pigs except 1 lot which came from a peccary. They are of the Asiatic type. It appears, therefore, that the common sucking louse of domesticated North American pigs is the Asiatic form, and is nearest to the variety *chinensis* Fahrenholz. Hence the proper name of the common sucking louse of North American domesticated pigs becomes *Haematopinus adventicius chinensis* Fahrenholz.

A case of prolonged cecal coccidiosis. Ena A. Allen.

A chicken hatched November 2, 1933, was inoculated with *Eimeria tenella* January 3, 1934. At the close of the experiment, 2 months and 13 days later, it was killed. This bird had received no treatment, but was among others which served as controls for treated chickens.

Fig. 26
Cecal core from a chronic case of an infection with *Eimeria tenella*. Natural size.

When killed, it was emaciated and the ceca contained cheesy cores, stained with fresh blood, one of which was very large (fig. 26). In the interior of each core were large numbers of oöcysts in great masses, which did not sporulate when left for 1 week in 2 percent potassium dichromate. During the month preceding necropsy, oöcysts of coccidia could not be found in the droppings of any of the chickens of this experimental group. These chickens were kept in cages having wire floors and the food and drinking vessels were so arranged as to prevent contamination by droppings; also the cages were cleaned daily to prevent reinfection.

It appears from these observations that this was a case of *Eimeria tenella* of over 2 months duration, which is about twice the length of time that an infection with this species of coccidia ordinarily remains in a chicken.

MINUTES

One hundred sixty-first to one hundred sixty-fourth meetings

The 161st meeting was held February 17, 1934. Papers were presented by Miss Jones, and by Messrs. Chitwood and Steiner (see this issue). Papers were also presented by Messrs. Hegner and Wright, which will appear elsewhere.

The 162nd meeting was held March 17, 1934. Papers were read by Messrs. Chitwood, Courtney, Dikmans, Ewing and Steiner (see this issue).

The 163rd meeting was held April 21, 1934. Papers were read by Misses Allen, Cram and Cuvillier, and by Messrs. Chitwood, Ewing, Krull, Price, Ward and Wehr (see this issue).

The 164th meeting was held May 19, 1934. Papers were presented by Miss Cram and Messrs. Alicata, Chitwood, Dikmans, Ewing and Krull (see this issue). Papers were presented also by Mrs. Shorb and by Messrs. Chu and Shorb, which will appear elsewhere. Dr. Cooper Curtice reviewed briefly some facts relative to early work on cattle ticks.

L. A. SPINDLER, *Secretary*

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